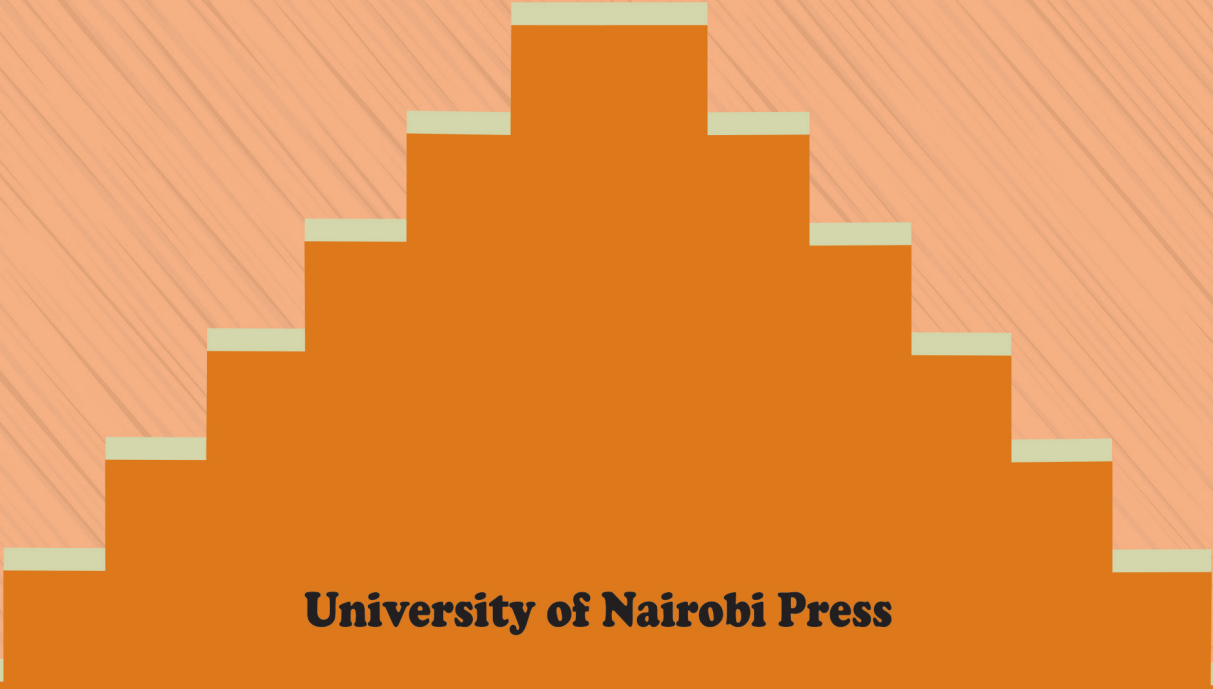


Reproductive Health, Economic Growth and Poverty Reduction in Africa

Frameworks of Analysis

Edited by

**Olu Ajakaiye
Germano Mwabu**



University of Nairobi Press

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African Economic Research Consortium

First published 2010 by
University of Nairobi Press (UONP)
Jomo Kenyatta Memorial Library
University of Nairobi
P.O. Box 30197 – 00100 Nairobi
E-mail: *nup@uonbi.ac.ke*
Website: *www.uonbi.ac.ke/press*

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University of Nairobi Library CIP Data

Reproductive health, economic growth and poverty reduction in Africa / ed. by
Olu Ajakaiye and Gemanu Mwabu.

434 pp

1. Reproductive health -- Africa
2. Family planning -- Africa -- Evaluation.
3. Poverty -- Africa.

HQ 766.5.A35 R37

ISBN 9966-846-85-9

Printed by

English Press Limited
P.O. Box 30127 – 00100 GPO
Nairobi

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Abbreviations and Acronyms

2SLS	Two-stage least squares
3SLS	Three-stage least squares
ABC	Abstain, Be Faithful, Use Condoms
ACDIS	Africa Centre Demographic Information System
AERC	African Economic Research Consortium
AIDS	Acquired Immune Deficiency Syndrome
AIS	AIDS Indicator Survey
ANC	Antenatal Clinic
ANRS	Agence Nationale de Recherches sur le SIDA
ART	Anti-Retroviral Therapy
ARVs	Anti-Retroviral Drugs
BCG	Bacillus Calmette-Guérin
BMI	Body Mass Index
CBD	Community-based Distribution
CBR	Crude Birth Rate
CDR	Crude Death Rate
CFR	Cohort Fertility Rate
COPE	Client Oriented/Provider Efficient
CYPs	Couple Years of Protection
DAC	Development Assistance Committee (of the OECD)
DALYs	Disability Adjusted Life Years
DHS	Demographic and Health Survey
DID	Difference-in-difference
DPT	Diphtheria, Pertussis and Tetanus vaccine
DRC	Democratic Republic of Congo
DT	Diphtheria and Tetanus
EPI	Expanded Programme on Immunisation
EPP	Epidemiological Programme Package
FA	Financing Agents
FBO	Faith-based Organisation
FGI	Futures Group International
FGM	Female Genital Mutilation

FIML	Full Information Maximum Likelihood
FHOK	Family Health Options Kenya
FP	Family Planning
FPAK	Family Planning Association of Kenya
FS	Financing Sources
FWV	Family Welfare Visitor
GDP	Gross Domestic Product
GOI	Government of India
GOR	Government of Rajasthan
HA	Health Accounts
HDI	Human Development Index
HF	Financing Agents
HIV	Human Immunodeficiency Virus
HMO	Health Maintenance Organisations
HNP	Health, Nutrition and Population
HRC	Health-related Categories
ICD	International Classification of Diseases
ICHA-FS	International Classification for Health Accounts – Financing sources
ICHA-HC	International Classification for Health Accounts – Health care
ICHA-HF	International Classification for Health Accounts – Financing agent
ICHA-HP	International Classification for Health Accounts – Providers
ICPD	International Conference on Population and Development
IEC	Information, Education and Communication
IIHMR	Indian Institute for Health Management Research
IMR	Infant Mortality Rate
IPPF	International Planned Parenthood Federation
IPS	Institute of Policy Studies (Bangladesh)
IPTp	Intermittent Prophylactic Treatment for Malaria in Pregnancy
IUCD	Intra-uterine Contraceptive Device
IV	Instrumental Variable
KHDS	Kagera Health and Development Survey (Tanzania)
LG	Local Government
LIML	Limited Information Maximum Likelihood
MCH	Maternal and Child Health
MDGs	Millennium Development Goals
MHO	Mutual Health Organisation
MLE	Maximum Likelihood Estimation
MMM	Maternal Mortality and Morbidity

MMR	Maternal Mortality Ratio
MOH	Ministry of Health
MTP	Medical Termination of Pregnancy
NGO	Non-Government Organisation
NHA	National Health Account
NIDI	Netherlands Interdisciplinary Demographic Institute
NMR	Neonatal Mortality Rate
NRR	Net Reproduction Rate
OECD	Organisation for Economic Cooperation and Development
OHS	October Household Survey (South Africa)
OLS	Ordinary Least Squares
OPV	Oral Polio Vaccine
P (Health)	Providers
PAI	Population Action International
PEPFAR	President's Emergency Plan for AIDS Relief
PETS	Public Expenditure Tracking Surveys
PHC	Primary Health Care
PHRplus	Partners for Health Reform <i>plus</i>
PLWHA	Person/people Living with HIV/AIDS
PMTCT	Prevention of Mother to Child Transmission (of HIV)
PSI	Population Services International
QALY	Quality-adjusted Life Year
QSDS	Quantitative Service Delivery Surveys
RCH	Reproductive and Child Health
RCT	Randomised Controlled Trial
RDD	Regression-discontinuity Design
RF	Resource Flows
RFB	Regional Finance Bureaus
RH	Reproductive Health
RHA	Reproductive Health Account
ROW	Rest of the World
RTI	Reproductive Tract Infection
SAMM	Severe Acute Maternal Morbidity
SEM	Structural Equation Model
SIDALAC	Regional AIDS initiative For Latin America and the Caribbean
SNA	System of National Accounts
SRH	Sexual and Reproductive Health
SSA	Sub-Saharan Africa

STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infection
SWAp	Sector-wide Approach
TB	Tuberculosis
TCEH	Total Current Expenditure on Health
TFR	Total Fertility Rate
TT	Tetanus Toxoid
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
UK	United Kingdom
USAID	United States Agency for International Development
VCT	Voluntary Counselling and Testing
WHO	World Health Organisation
WPP	World Population Prospects
WRA	Women of Reproductive Age

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Foreword

Collected in this book are the framework papers prepared for the collaborative research project on *Reproductive Health, Economic Growth and Poverty Reduction in Africa*, one of several collaborative research projects supported by the African Economic Research Consortium (AERC) in Sub-Saharan Africa. The project was generously funded by the William and Flora Hewlett Foundation. AERC is deeply grateful to the Foundation for supporting this work. We also sincerely thank the chapter authors, the editors, and the external reviewers for the work they did.

The framework papers deal with the nature and scope of reproductive health care, the processes through which reproductive health is accumulated, and the linkages between better reproductive health, economic growth and poverty reduction. Besides being immensely valuable in their own right, the chapters served as a guide to the country case studies conducted under the project.

One important argument in the book is that enhancement of women's health human capital is key to raising household incomes and improving health outcomes of the next generation. The chapters in this book reveal the nexus between primary health care and reproductive health, and the policies that must be implemented in order for economies to experience both growth and poverty reduction as the reproductive health of the population improves.

I strongly recommend this insightful book to policy makers, health professionals, development economists, students of economics and public health, and to anyone interested in understanding the mechanisms through which better reproductive health can make a nation prosper.

William Lyakurwa
Executive Director, AERC

Preface

This book examines the relationships between reproductive health, economic growth, and poverty reduction in Africa and, in light of the evidence generated on these linkages, recommends policies for realising long-term prosperity on the continent. The main thrust of the book is that Sub-Saharan Africa is not likely to reduce poverty and achieve sustainable growth until the reproductive health of its people improves. To support the policy environment that can make this happen, the volume provides an essential background for policy makers and outlines some very specific approaches to both policy and project design and programme implementation.

It is necessary to point out that the three phenomena analysed in the book, namely, better reproductive health, economic growth, and poverty reduction are not inherently connected. The links need to be created deliberately through public policy. The reproductive health of a population can improve without an increase in economic growth or a reduction in poverty if a conducive business environment does not exist. It is unlikely, however, that sustainable poverty reduction can be achieved in a situation in which maternal mortality ratios, infant mortality rates, and HIV prevalence are as high as they are currently in Africa.

Briefly, the effect of better reproductive health on people's material well-being depends on the quality of the policy and institutional environments in an economy. In a favourable environment, healthy people have an incentive to use their vigour to innovate and create development opportunities for themselves. Thus, along with improving reproductive health services, institutional policies are needed to improve the functioning of labour markets, such as tripartite arrangements among government, trade unions and employers that can set wages at levels that increase employment opportunities. Such arrangements can reduce wastage of the skills of healthy people who cannot find work. In the same vein, the availability of markets for goods, as in negotiated regional trading blocs, can prevent wastage of domestic output resulting from elastic supplies of labour in a healthy population.

Examples of the issues analysed in the book include demographic profiles of the population, the nature of the demand- and supply-sides of reproductive health care markets, cost-effectiveness in the provision of reproductive health services, utilisation and financing of these services, labour market outcomes, returns to reproductive health, household behaviours, HIV/AIDS, growth and poverty, and demographic dividends resulting from better reproductive health.

We wish to thank our colleague, Prof. William Lyakurwa, the Executive Director of AERC, for his advice at the initial stages of this work. We thank Margaret Crouch, for her technical editorial advice. We appreciate the support provided by Charles Owino, AERC Communications Division Manager, and Lydiah Kiraka-Auma, Publications Administrator. We are indebted to the team of editors at the University of Nairobi Press for advice and constructive criticism. However, we are solely responsible for any errors in the work we did as editors.

Olu Ajakaiye
Germano Mwabu
June, 2010
Nairobi

Overview: The State of Reproductive Health in Africa

Germano Mwabu and Olu Ajakaiye

The chapters in this volume deal with the nature and scope of reproductive health care services, the accumulation of reproductive health, and the linkages from reproductive health to economic growth and poverty reduction. The book further examines systems for the provision and financing of reproductive health care services in sub-Saharan Africa, with particular reference to the National Health Accounts.

The Nexus among Reproductive Health, Economic Growth and Poverty Reduction

The crux of the issues examined in this book is the set of mechanisms through which reproductive health, economic growth and the poverty status of households are intertwined (Ajakaiye and Mwabu, 2007a). Several behavioural, institutional and market channels link reproductive health, economic growth and poverty rates in a population. One such channel is the consumption of reproductive health care services. Reproductive health care services, which are delivered through national health systems are the inputs into better health. Individuals and households demand and use these inputs to improve and accumulate reproductive health, which are both a factor of production and an intrinsic good. Because an important consideration in the delivery of reproductive health services is efficiency, cost-effective delivery of services has two welfare consequences. First, efficiency lowers the cost of using the services, enabling households through substitution and income effects, to increase service consumption and produce higher levels of reproductive health. Second, by lowering unit costs of service provision, cost-effectiveness at public health facilities enables governments to attend to other needs, including providing greater income subsidies to low-income households, thereby helping them move out of poverty.

More generally, cost-effectiveness in the provision of social services, reproductive health care services included, strengthens the social protection systems that governments can use to reduce poverty directly (Mwabu *et al.*, 2001). However, while the savings resulting from cost-effective provision can have the effect of reducing poverty in the short term by financing direct income subsidies to the poor, when these savings are used to subsidise the prices of reproductive health care

services they can reduce poverty only in the medium to long term because health investments take time to yield returns. It should be noted that from a welfare perspective, the subsidies used to augment incomes of the poor are not equivalent to the subsidies that are spent to make reproductive health services broadly accessible to the poor.

In the case where subsidies are used to augment incomes, households may spend part or all or none – of the subsidy they receive to consume reproductive health care services. Since households have the freedom to spend the subsidy in accordance with their own perceptions of marginal costs and benefits of reproductive health care relative to other goods, they have the opportunity to attain a higher level of private welfare than in the case where they are restricted to use the entire subsidy on reproductive health care. Even so, restriction on how the subsidy income might be spent ensures that a good that has a high weight in the social welfare function will be consumed, thus enhancing the wellbeing of the whole society, as when households appropriately utilise immunisation or family planning services. The answer to the question as to which modalities should be used to reduce poverty through provision of reproductive health care services depends on the information available on social externalities that are conferred to society when individuals consume reproductive health care services and on the feasibility of available approaches to service provision (Ajakaiye and Mwabu, 2007b).

Although by averting and curing illnesses, consumption of reproductive health care directly enhances the welfare of households and society, it increases incomes only when it improves labour productivity by improving health. An important point to note is that if the additional healthy days made available through improvements in reproductive health care are not used for productive purposes, household incomes and poverty status would not change. Thus operations of labour markets are key to the translation of better reproductive health into higher incomes and to lower poverty rates.

Labour markets in wage and non-wage settings help households translate better health into higher incomes and enable them to move out of poverty, if two conditions hold. The first condition is the availability of opportunities to participate in labour markets, and the second is sufficient remuneration of the available employment. Improvement in reproductive health increases the number of healthy days in the population, particularly of women and children, thus enabling individuals to reduce the time spent away from work either in a state of sickness or in caring for the sick. An increase in work effort or a reduction in work absenteeism owing to better health enhances labour productivity and remuneration both in the formal and informal sectors and in wage and non-wage environments. Moreover, even in the absence of employment opportunities, healthy individuals are more likely than sick persons to have the necessary physical vigour and cognitive skills to innovate and create the missing opportunities.

Social institutions such as minimum wages, as well as mechanisms to resolve trade union disputes and to improve the functioning of monopsonistic or segmented labour markets, are needed to increase labour force participation and improve labour remuneration. In addition to well-functioning labour markets, social protection policies are required to ensure equity in utilisation of reproductive health care services and in health outcomes. The design of these institutions is hindered, however, because of the paucity of data on how labour markets and social protection systems in Africa function. This is an important new area of research.

Also needed in the fight against poverty through better reproductive health, are markets for the goods produced by the principal beneficiaries of reproductive health services, i.e., men and women of reproductive age. Availability of domestic and foreign markets for these goods creates opportunities to use additional healthy days, resulting from better reproductive health to produce goods for those markets. The challenge is to find production technologies that would make the prices of such goods competitive particularly in external markets. To address widespread poverty, it is also necessary to create markets for goods and services whose production is intensive in the use of the time of poor people in rural areas and urban slums. A key factor here is the country's macroeconomic framework, such as the rules governing the operations of monetary and fiscal policies, the foreign private investments, and the acquisition and use of foreign debt.

There are two principal beneficiaries of reproductive health care services. These are adults and children whose health improvements have different consequences for household incomes and poverty reduction. The enhancement of women's health human capital, through for example better antenatal and postnatal care, increases the potential labour supply of women so that whenever this potential is realised, there is an increase in household incomes for the current generation. An improvement in child health boosts the household income of the current generation by diverting adult time from the care of sick children to productive activities, and increases labour productivity of the future generations through its favourable effects on the development of motor and cognitive skills. Thus, provision of reproductive health services has huge implications for the incomes and poverty status of current and future generations.

It can be deduced from the foregoing that reproductive health can improve without growth occurring. Moreover, growth can occur without a significant reduction in poverty, and without improvements in reproductive health. However, the triunity of better reproductive health, economic growth and declining poverty is likely to be found in an environment in which labour and product markets function, and in which a macroeconomic framework exists that encourages domestic and foreign investments and promotes social protection for current and future generations.

Overview of the Volume

Part I of this volume (Introduction and Overview) contains two background chapters, including this one. The four chapters of Part II (Provision and Utilisation of Reproductive Health Services) study demand for reproductive health services, organisation and financing of these services, and the construction of reproductive health accounts. In Part III (Linking Reproductive Health to Growth and Poverty) seven chapters analyse the causal relationships between growth and poverty, with a focus on the role played by behaviours, HIV/AIDS, maternal health, fertility, returns to reproductive health, and labour market activities.

Following this overview, Chapter 2, by J. Patrick Sevilla, explains basic demographic concepts and principles, illustrating how they could be applied to analyse the nexus among demographics, health, growth and poverty, particularly over time.

In Chapter 3 (Part II), Olu Ajakaiye and Germano Mwabu present frameworks for analysing the utilisation and distribution of reproductive health services using unitary and collective models of the household. The data requirements for estimating these models are discussed, with illustrations from previous studies. The chapter discusses the features of the demand side of reproductive health care services. On the supply side, Joseph Wang'ombe and Mercy Mugo in Chapter 4, present a generic organisational scheme of reproductive health service provision, indicating the various methods of service delivery and management that providers can employ to reach underserved populations. Implications of different service delivery modes for efficiency and cost-effectiveness are discussed. The authors conclude that differences in design and operations of the various delivery systems are determined by specific social-cultural and economic circumstances of countries. Key, in this regard, are the cultural traditions and a society's value systems surrounding the utilisation of reproductive health care services. The authors find a need for comparative evaluative studies on performance of different provision models, particularly in the areas of cost-effectiveness and equity in service delivery.

In Chapter 5, Nana Enyimayew looks at the role of user fees, taxation, foreign aid and other forms of financing in paying the bill for reproductive health services in Africa. A point of great interest in this chapter is how to reduce waste in public funding. He notes that the available resources are not sufficient to allow poor countries to provide quality services and says the lack of financial resources jeopardises the achievement of Millennium Development Goal targets. Chapter 6, by Adoyin Soyibo and Olakunle Odumosu, presents specific details of how reproductive health accounts can be constructed, discussing the relevance of the accounts to the financing of reproductive health services. The authors use the established methods and concepts of constructing national health accounts (NHA) to motivate the framework for constructing reproductive health accounts. The chapter also reviews the literature on the construction and application of NHA. The review forms the basis for a scheme for classifying reproductive health services

and activities, which the author use to illustrate how reproductive health accounts can be constructed.

Ali A.G. Ali's Chapter 7 opens Part III with a discussion of the relationships between demographics, growth and poverty, demonstrating how this linkage can be analysed at the micro and macro levels. J. Patrick Sevilla, in Chapter 8, discusses a macroeconomic perspective of the impacts of demographics on growth, income distribution and poverty.

Chapter 9 by David Bloom, David Canning, Günther Fink and Jocelyn Finlay examines the potential for realising demographic dividends in Africa. The authors, indicate that under a certain policy environment, demographic transition can significantly enhance growth in Africa as well as women's participation in the labour force. The chapter concludes that the African region is not different from the rest of the world with respect to the factors that determine economic growth, and that in general, the standard economic growth model is relevant in the design of growth-enhancing policies on the continent.

Peter Glick, in Chapter 10, examines the important issue of HIV/AIDS in sub-Saharan Africa. Multiple linkages are specified and analysed in areas of reproductive health, HIV/AIDS, household behaviours, labour market participation, and the strategies available to treat and prevent this deadly disease. The effects of the pandemic on children and investments in human capital are analysed.

A wide ranging and meticulous survey of the literature forms a significant contribution of this chapter. Among other conclusions, Glick finds indications of substantial externalities to households and children from supplying anti-retroviral drugs (ARVs) to adults, but he says the long-run benefits of scaling up ARV therapy remain unknown and the benefits to children appear to be short-lived. Glick also indicates that variations in the design of programme evaluations and assessments make it difficult to draw definitive conclusions on the effectiveness of many HIV and AIDS interventions.

Relationships among poverty, maternal morbidity and mortality in sub-Saharan Africa is the subject of Chapter 11 by Chad D. Meyerhoefer and David E. Sahn. Issues of endogeneity, heterogeneity and sample selection bias that arise in the estimation of these relationships are studied in detail. Meyerhoefer and Sahn conclude from their literature review that good maternal health is of fundamental importance to Africa's future. They note that protecting the health of mothers during reproduction safeguards their future contributions to society and enhances the health and productivity of future generations. In particular, poor health of mothers or their newborn offspring has serious negative consequences for families and communities.

In Chapter 12, Stephen Younger links women's labour market activity to poverty and fertility. He presents a framework for examining the interactions between fertility (child quantity) and investments in children (child quality), linking this interaction to mother's human capital. A micro level consequence of this interaction

for women's participation in the labour market is explored in detail. Germano Mwabu rounds out the volume in Chapter 13 with models for estimating returns to reproductive health using illustrations based on African data. He demonstrates that there are large returns to reproductive health in Africa.

Conclusion

Together, the 13 chapters in the book constitute a robust framework for analysing reproductive health in Africa, including an assessment of its correlations with economic growth and poverty reduction. In general, the data required to implement the analytic models presented in the book are generally available in government ministries and in the research institutions of countries studied. Qualitative data, however, which are essential for detailed analysis of the nexus among reproductive health, economic growth and poverty reduction, will need to be collected. Data for cost-effectiveness analyses are also not readily available and researchers interested in this area of investigation will need to collect their own data.

References

- Ajakaiye, Olu and Germano Mwabu. (2007a), "Reproductive Health, Economic Growth and Poverty Reduction: A Framework", Presentation made at the Second Annual Research Conference on Population, Reproductive Health and Economic Development, sponsored by Population Reference Bureau and the Hewlett Foundation, Arusha, Tanzania, December 8–9, 2007.
- Ajakaiye, Olu and Germano Mwabu. (2007b). "The Demand for Reproductive Health Services: Frameworks of Analysis", African Economic Research Consortium (AERC), Nairobi, Mimeo.
- Mwabu G., C. Ugaz and G. White. (2001), eds. *Social Provision in Low-income Countries*, Oxford: Oxford University Press.

Population Dynamics: Demographic Concepts and Processes

J. Patrick Sevilla

Demography is the discipline whose primary concern is measuring the size and changes in size and composition of populations over time. It may encompass, in addition, the consequences of demographic changes on important social processes such as growth and economic development. From time immemorial, states and governments have made efforts to collect information on population size, composition and dynamics. These efforts were motivated by the need to tax populations, form armies, detect epidemics, form viable political and socio-economic units, and provide adequate social services such as policing, health services and schools.

Demography is no less relevant today. Many of the key challenges of development in Africa and the rest of the world are locked in the complex relationships of demographic processes. Some of these challenges include the hurdles to economic development caused by high fertility rates, the need to provide old-age security for aging populations, the impact of HIV/AIDS mortality on the number of prime-aged adults, and the movement of people from rural to urban areas within countries or from poorer countries to wealthier ones.

Thus, the dynamics of populations depend centrally on trends in fertility, mortality, and migration. The relationship between mortality and fertility is critical for development. Mortality decline is an intrinsic good and should be a central goal of policy alongside other goals like income growth, literacy promotion or poverty reduction. Fertility decline, while in and of itself is not an intrinsic goal of policy, is often thought to be a necessary condition for socio-economic development, with persistently high fertility being believed by many to be one of the most important obstacles to African development. Understanding the relationship between mortality and fertility will inform policy makers who have strong reasons to care about both health and development.

Another reason for understanding demographic relationships is that recent research in economic demography has argued that demographic transition creates dynamic changes in the size and age structure of populations, which pose both challenges and opportunities for development, that need to be understood by policy makers. What is the relevance of these ideas for Africa? The developed nations have largely

completed their demographic transitions and are confronting post transition scenarios of very low fertility and rapidly aging populations. The less developed nations are currently in the process of completing their fertility transitions, and experiencing age structures with high working age shares. Africa, particularly sub-Saharan Africa, was a latecomer to the mortality transition, which only started in the mid-twentieth century and occurred more slowly than it did anywhere else in the developing world, and stalled and even partially reversed itself in the late twentieth century because of the combined effects of the AIDS epidemic, political instability and violence, and infectious diseases. Thus, the fundamental challenge of reducing mortality remains large. Africa must learn from what is known about how to reduce mortality and pursue mortality reduction strategies with the utmost urgency. The fertility transition in Africa has only barely begun as a full two-thirds of sub-Saharan Africa's population still has total fertility rates above 5. Unless this fertility rate declines, the continent will be unable to enjoy the demographic dividend that is more fully described elsewhere in this volume.

The nature of the link between mortality and fertility remains remarkably contested, despite its universally acknowledged intuitive appeal. The primary difficulty is that it is generally very difficult to make causal inferences about large scale historical processes, whether demographic, socio-economic, or cultural. This primary difficulty reveals itself more particularly in the specific pathways through which mortality, socio-economic development or changes in cultural norms affect fertility, as well as in accounting for the relative timing or sequencing of the mortality and fertility transitions. These difficulties have at times led demographers and other social scientists to ignore or downplay the link between the two transitions, or to study each of the transitions independently of the other.

Yet despite these difficulties, it seems reasonable to assert that mortality and fertility are causally linked. Many of the hypothesised pathways are intuitively plausible, even though some are more empirically testable than others. Those that are testable have received some empirical support. And even those that are not empirically testable should not necessarily be dismissed out of hand, since they may still provide coherent frameworks for interpreting what would otherwise be a mere jumble of diverse empirical patterns.

The Demographic Equation

The basic demographic equation states that the population of a country at some point in time is by definition equal to its population at some previous point in time, plus the inflow of new people into that population during the interval between those two points in time, minus the outflow of people from that population during that interval. The inflow of new people consists of births and immigrants, while the outflow consists of deaths and emigrants. More precisely:

$$population_{t+1} = population_t + (births_t + immigration_t) - (deaths_t + emigration_t)$$

which can be rewritten as

$$population_{t+1} = population_t + (births_t - deaths_t) + (immigration_t - emigration_t)$$

$$population_{t+1} = population_t + natural\ increase_t + net\ migration_t$$

where

$$natural\ increase_t = births_t - deaths_t$$

$$net\ migration_t = immigration_t - emigration_t$$

All the major demographic concepts revolve around the demographic equation: births or fertility, death or mortality, and migration, as well as particular ways of disaggregating population: by gender, age, urban or rural residence. This chapter discusses each of these major concepts of fertility, mortality and migration, providing a look at the history of demographic studies on each topic, the major theories and the research frontier.

Population Sizes and Trends

It is clear from the fundamental equation of demography that populations are dynamic – that is, they change over time. They may grow bigger or smaller, younger or older, be more concentrated in cities or certain regions, and they may even change in the relative presence of men and women. Most of these changes are driven by three fundamental demographic processes: people being born (fertility), people moving (migration) and people dying (mortality).

Here we briefly review some definitions of the characteristics of populations. The definitions are obtained from *World Population Prospects – WPP* (UN, 2005). These are:

Population size: this is a reference to the de facto population in a country, area or region; *Population density*: population per square kilometer; *Population growth rate*: Average exponential rate of growth of the population over a given period. It is calculated as $\ln(P_t/P_0)/t$ where t is the length of the period; The *rate of natural increase* or *rate of intrinsic growth* is simply the difference in births and deaths. It is a measure of how population size changes occur from within, that is, ignoring the impact of migration, and focusing only on births and deaths.

The world's population stood at 6.5 billion in the year 2005, which is about 4 billion more than it was in 1950, and is projected to grow to 9 billion by the year 2050. As can be observed from Table 2.1 Africa is the fastest growing region of the world. Its population more than tripled between 1950 and 2005 and is projected to more than double from 2005 to 2050. In each 50-year period since 1950 Africa's share of the world population has increased by about 5 percentage points, from about 9 per cent in 1950 to 15 per cent today, to about 20 per cent in 2050. Southern Africa itself, however, is expected to have either population declines or only slight increases, primarily because of the HIV epidemic. For example, only Namibia is expected to experience a substantial population growth because of its high fertility

rate. South Africa, which has the largest population in Southern Africa, will grow by only 3 per cent over the period 2005 to 2050, while Botswana and Lesotho are expected to have population declines of 6 per cent and 11 per cent, respectively. Swaziland is expected to have population declines until 2030, and then experience population increases till 2050, this will only be sufficient to bring its population back to its 2005 state.

Table 2.1: Population by development group and major areas

Development group or major area	Population			Percentage distribution		
	1950	2005	2050	1950	2005	2050
World	2519	6455	9076	100.0	100.0	100.0
More developed regions	813	1211	1236	32.2	18.7	13.6
Less developed regions	1707	5253	7840	67.7	81.3	86.4
Least developed countries	201	759	1735	8.0	11.7	19.1
Other less developed countries	1506	4494	6104	58.8	68.5	67.3
Africa	224	906	1937	8.9	14.0	21.3
Asia	1396	3905	5217	55.4	60.4	57.5
Europe	547	728	653	21.7	11.3	7.2
Latin America and the Caribbean	167	561	783	6.6	8.7	8.6
Northern America	172	331	438	6.8	5.1	4.8
Oceania	13	33	48	0.5	0.5	0.5

Source: World Population Prospects (UN, 2005).

Throughout most of human history, population growth was probably very low. It was probably not until the seventeenth and eighteenth centuries that annual growth rates reached about 0.5 per cent, where they stayed until the turn of the twentieth century. Improvements in health particularly among the young, to be discussed in more detail later, led to a reduction in deaths, which caused global population growth rates to rise until they peaked at about 2 per cent during 1965–1970. Subsequent declines in fertility caused population growth rates to decline considerably. Today, the global population growth is around 1.2 per cent, and in the medium variant projection of the UN, is projected to return to the very long-run historical levels of 0.5 per cent. The WPP (UN, 2005:15) states that rapid population growth of the twentieth century may come to be seen as an extraordinary but historically isolated phenomenon.

One of the most fundamental questions in the long history of thought in development is whether population growth was a threat to economic development, a fear that reached its height a few decades ago when, the population explosion, led to fears of mass starvation and famines. In fact, the idea that population growth was a threat to development received its earliest important articulation from Malthus's *First Essay on Population*, written in 1798 (Malthus, 1959:9), in which he argued:

Taking the population of the world at any number, a thousand millions, for instance...the human species would increase in the ratio of 1, 2, 4, 8, 16, 32, 64, 128, 256, 516, etc. and subsistence as 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, etc. In two centuries and a quarter the population would be to the means of subsistence as 512 to 10; in three centuries as 4096 to 13, and in two thousand years the difference would be incalculable.

Thus progress in food production is always threatened by population pressure, and although agricultural innovations and discoveries of new resources may cause improvements in the standards of living, these can only be temporary. Rising prosperity sets in motion more rapid population growth, which drags living standards back to subsistence levels. Malthusian pessimism was reawakened in the 1960s, as exemplified by Ehrlich (1968:xi). The who state that battle...is over. In the 1970s, hundreds of millions of people are going to starve to death”.

The second half of the twentieth century proved the alarmist versions of pessimism to be wrong. At a global level, this has been a period of rapid population, rapid economic growth. In the past few decades, world per capita incomes have increased by about two-thirds and the world population has grown by over 2 billion (Bloom *et al.*, 2002). Famines have occurred, but Ehrlich's, hundreds of millions of people, have not starved. Technological progress, in both agriculture and industry, has been more rapid than at any other time in human history. There have been equally dramatic social and institutional innovations, in the way people work, the standard of their education and health, and the extent to which they participate in the political process. Rather than being constrained by fixed resources, the world has experience a decline in the prices of raw materials in the long-term. Inflation (for the moment at least) is quite low, and some parts of the economy are becoming dematerialised, as the knowledge revolution kicks in.

While alarmist projections seem largely and appropriately discredited, there remain more sober and carefully reasoned accounts of why large populations and high population growth pose challenges for development. One focuses on the possible effect of population growth on, diluting, a society's material resources, which have to be spread out to more people. The canonical Solow (1956) model of economic growth remains the foundation of the modern economics profession's view of the relationship between population growth and economic welfare. In that model, population growth lowers levels of per capita consumption because productive resources need to be spread out over a larger number of people, lowering each person's stock of productive resources, and therefore that person's product and wellbeing. Another strand focuses on the possible effect of population growth on, diluting, a society's human capital. Larger population growth invariably occurs through growing numbers of dependent children that jeopardise society's and households' capacities to invest sufficiently in their nutrition, health and education (Becker and Lewis, 1973). In cases of dilution of both physical and human capital, economic growth is threatened and the likelihood of poverty rises.

Population pessimism has centred around the idea that population dilutes natural resources, physical capital and/or human capital, but a rival optimist view has focused on the potential positive impacts that population growth might have on ideas, innovation, and technology. Optimism has an older and equally venerable lineage as we pessimism. As early as 1682, William Petty argued that larger populations meant more innovation:

As for the arts of delight and ornament, they are best promoted by the greatest number of emulators. And it is more likely that one ingenious curious man may rather be found among 4 million than 400 persons.... And for the propagation and improvement of useful learning, the same may be said.... (1682/1899, p. 474, quoted in Simon, 1998: 309)

More recently, optimist views have been expressed by Simon Kuznets (1967) and Julian Simon (1981), who argue that population increases serve to augment the stock of human ingenuity and allow economies of scale. Boserup (1981) argues that population growth creates pressures on resources, but thereby stimulates innovations to counteract these pressures. Thus, innovation is borne of adversity.

Population Composition

Populations are generally described by various characteristics such as gender ratios, age cohorts and dependency ratios, as well as individuals' area of residence, whether urban or rural. These are described below.

Gender ratios

Key concepts here are the *population gender ratio*, which is the number of males per 100 females in the population, and the *gender ratio at birth*, which is the number of male births compared to that of female births in the population.

According to Sen (1990), the ratio of women to men in the population is about 1.05 in the developed world, but as low as 0.95 in some parts of the developing world, particularly in South, West Asia and China. This simple statistic raises profound issues that need to be understood. At birth, males always tend to outnumber females by about 1.05 male births for every female birth. Subsequently, however, biology always seems to advantage women. As Sen (1990, <http://www.nybooks.com/article/3408>) says:

Considerable research has shown that if men and women receive similar nutritional and medical attention and general health care, women tend to live noticeably longer than men. Women seem to be, on the whole, more resistant to disease and in general hardier than men, an advantage they enjoy not only after they are forty years old but also at the beginning of life, especially during the months immediately following birth, and even in the womb. When given the same care as males, females tend to have better survival rates than males.

The fact that the ratio is so low in parts of Asia led Sen to theorise that women are dying sooner because of social gender bias in the allocation of resources such as food, health care and social services. This gender bias is not exclusively a function of poverty. Sub-Saharan Africa, which is the poorest continent, at birth, has a relatively healthy female to male ratio of 1.02. And in India, some of the wealthiest states have low ratios and some of the poorest states have high ratios. Estimating how many women ought to have been alive in such gender biased societies by using the female to male ratio of 1.05; Sen estimated that there are 100 million “missing women.” About a decade later, however, Oster (2005) proposed that hepatitis B may account for about 45 per cent of the missing women problem, so that gender bias cannot provide a full account of the situation, and that disease epidemiology is an important component of it. Pregnant women with hepatitis B, for reasons not yet fully understood, are far more likely to give birth to boys than girls: the sex ratio at birth is 1.5 boys per girl. Hepatitis B is also prevalent among the countries in which there seem to be missing women.

Age

The sizes of the different age groups in a population are critical. This is because people of different ages have different socio-economic functions in a population. The young have to be fed, clothed, housed, schooled and provided with health care. They are net consumers of resources, in that they usually consume more resources than they produce through their work. Adults, on the other hand, are net producers of resources, and comprise the primary age group upon which society relies for productive economic activity. It is the surplus of their economic product over and above their own consumption that is allocated for the consumption needs of the young and the elderly. And in old age, a final reversal takes place. The elderly, like the young, return to being net consumers of resources.

The old either live off their savings from their adult lives, or are dependent on state- or family-provided support.

Median age

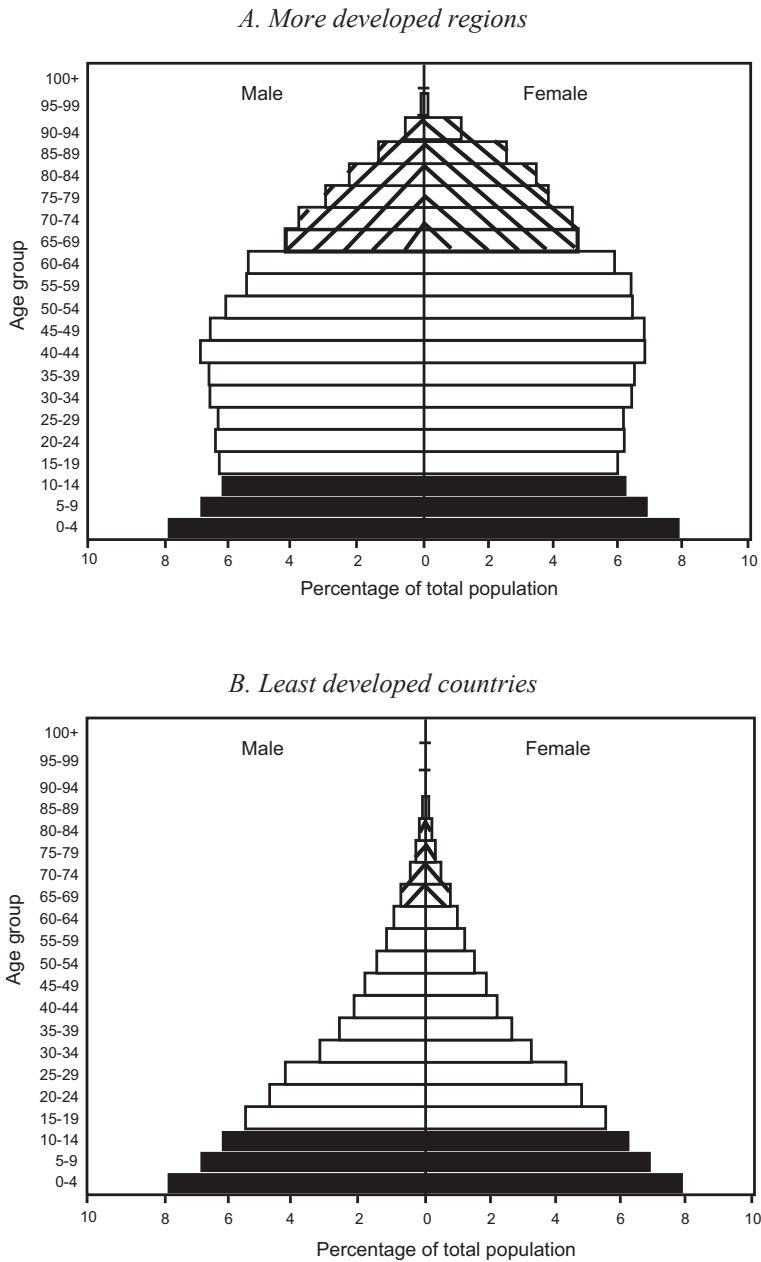
The *median age* divides the population into two parts of equal size; that is, there are as many persons with ages above the median as there are with ages below the median.

Dependency ratios

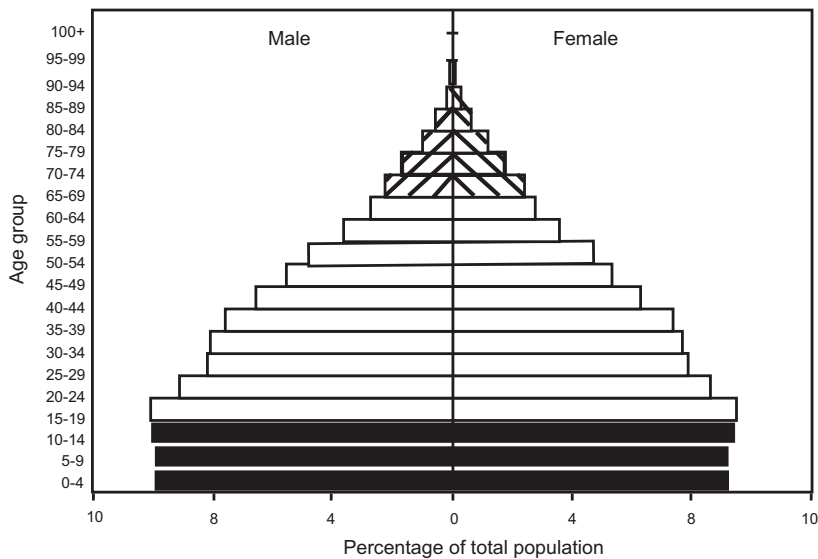
The *total dependency ratio* is the ratio of the sum of the population aged 0–14 and that aged 65+ to the population aged 15–64. The *youth dependency ratio* is the ratio of the population aged 0–14 to the population aged 15–64. The *old-age dependency ratio* is the ratio of the population aged 65 years or over to the population aged 15–64. All ratios are presented as number of dependants per 100 persons of working age (15–64).

The age structure of populations is often described graphically through *population age pyramids* such as those inclined in Figure 2.1, excerpted from UN (2005).

Figure 2.1: Population growth pyramids, by development group, 2005



C. Other less developed countries



The age pyramids reflect the differences in the extent to which the developed and less developed countries have undergone the demographic transition. As indicated, the low levels of fertility and mortality in developed countries are reflected in a pyramid that is thicker around ages 40 and up. In contrast, less developed countries that still have high fertility rates have very young age structures.

Area of residence

Population groups are usefully classified as urban or rural, depending on where they live:

Urban population which is the population living in areas classified as urban;
or *Rural population* which is the population living in areas classified as rural.

Birth Rates and Fertility

The *crude birth rate* (CBR) is the number of births over a given period divided by the person years lived by the population over that period. It is expressed as number of births per 1,000 population.

The *net reproduction rate* (NRR) is the average number of daughters a hypothetical cohort of women would have at the end of their reproductive period if they were subject during their whole lives to the fertility rates and the mortality rates of a given period. It is expressed as number of daughters per woman. It can also be interpreted as the average number of surviving daughters a woman would bear over the course of her lifetime, taking into account female mortality risks from birth

through the end of the reproductive period. When the NRR is greater than one, then an average woman is replaced by more than one daughter, implying that a population has an intrinsic tendency to grow. When the NRR is less than one, women are not sufficiently replaced and a population has an intrinsic tendency to decline. And when NRR is one, then a population has an intrinsic tendency to neither grow nor decline.

The *total fertility rate* (TFR) is the average number of children a hypothetical cohort of women would have by the end of their reproductive period if they were subject during their whole lives to the fertility rates of a given period and if they were not subject to mortality. It is expressed as children per woman.

Replacement fertility is a TFR of 2.1, which is the number of live births required to numerically replace a child's parents, with the excess 0.1 percentage point to allow for the probability that the child might die.

Sometimes, TFR is contrasted with the *completed* or *cohort fertility rate* or CFR, which is the actual average number of children born to a particular cohort of women. By definition, the CFR cannot be computed until a particular cohort finishes its childbearing years, and so it is rarely explicitly computed and is usually approximated by TFR.

The *fertility transition* is the process through which a country, after experiencing historically high and stable levels of TFR above 6 children per woman perhaps for centuries, begins a transition, usually lasting a few decades, in which fertility declines rapidly, resulting in TFR levels below 3, and sometimes below replacement. The causes of the fertility transition, however, remain unsettled.

Box 2.1: The concept of demographic transition

Recent work in demographic economics has reawakened interest in population age structure and its relevance for policy. This work has centred around the theory of demographic transition. This theory claims that pre-modern societies experience simultaneously high levels of mortality and fertility, which jointly produce a relatively stable population size with low average age. A mortality transition then occurs, coincident with modernisation and improvements in public health and nutrition, through which mortality rates decline, especially among children, causing rapid population growth and a decline in the average age of the population. With a lag of variable lengths across countries, the mortality transition thereafter causes the emergence of a fertility transition, which occurs as fertility decreases in response to mortality reductions. This shift creates a "baby boom" generation whose movement through the population age structure has excited development theorists for its potential to facilitate economic growth. After both mortality and fertility transitions have taken place, population dynamics restabilise at low fertility and mortality rates, and older populations.

When the baby boom generation is young, it raises the youth dependency burden of a population, which may depress savings and therefore economic growth (Coale and Hoover, 1958), and poses challenges associated with investing in the health and education of the young. When this baby boom generation reaches working age, it creates special opportunities for growth – called the demographic dividend – in the form of extra labour supply, higher savings and higher human capital (Bloom *et al.*, 2002). And as the baby boom generation ages, it creates special challenges in the form of greater social security, health and pension demands.

Population momentum refers to the impact that the size of the reproductive age cohort in a population has on the size of the cohort of infant and children of that population. The size of the birth cohort is a function of two things, the number of children per reproductive age woman, and the number of reproductive age women. Thus, a population that has a large cohort of reproductive age women will tend, all else equal, to produce larger cohorts of young children, who will in turn when they reach reproductive age, produce their own larger cohorts of young children.

In Europe, fertility began to decline after the mid-nineteenth century (Coale and Treadway, 1986). As Caldwell (2000) warns, however, although the classic demographic transition theory has the mortality transition occurring prior to the fertility transition, this may not have always been the case in the wealthy nations. In the developing world, fertility transition did not begin till after 1950, at which time fertility was above 6 and remarkably similar across continents – 6.5 in Asia, 6.6 in Latin America, 6.7 in Africa, and 7.1 in the Middle East and North Africa (Bongaarts, 2002). Remarkably, the 1950s saw a general increase rather than decrease in fertility. According to Dyson and Murphy (1985), this was due to declining ages of marriage in Latin America, and to a lesser extent in Asia and Africa. In Africa, the decline of birth spacing mechanisms and in pathological sterility also played a role (Cleland, 2001).

But from the 1950s to the 1990s, fertility fell by half to about 3.1. The largest declines occurred in Asia and Latin America, where fertility fell by just over 50 per cent, and the smallest in Africa, where fertility declined by only 15 per cent (Bongaarts, 2002). Bongaarts provides a good summary of the stylised facts about the transition. He assumes that a fertility transition begins in the year during which fertility declines by more than 5 per cent from the maximum recorded fertility rate during the period 1950–1990. By this convention, 23 developing countries started their transitions in the 1950s, 38 in the 1960s, 32 in the 1970s, and 7 in the 1990s, so that a total of 123 out of 137 developing countries started their transitions before 2000. Nevertheless, two-thirds of sub-Saharan Africa's population still has a fertility above 5, and has therefore had no or only incipient fertility transition.

Bongaarts (2002) finds that the empirical patterns in the data suggest distinct stages with their own dynamics. In the pretransitional stage, there is little relationship between fertility and socio-economic indicators such as life expectancy, education, income and urbanity. The transition seems to occur after some threshold level of socio-economic development is reached, although this threshold seems to decline over time. For example, life expectancy in countries starting their transitions in the 60s was 57.7, but had declined to 48.7 in countries starting their transitions in the 90s. The transition is associated with sharp increases in contraceptive use (Bongaarts and Johansson 2002). Once a transition starts, fertility declines rapidly in its initial stages and decelerates towards the later stages. For example, among countries starting their transitions in the 1960s, annual fertility declines were 0.15 in the 1970s, but 0.06 in the 1990s. The pace of initial fertility declines seems to be faster the higher the level of socio-economic development when the transition

starts, though not associated with the pace of socio-economic development itself. The pace of initial fertility decline also seems to slow the later in time a country enters the transition, which is compatible with the fact that these latecomer countries also begin their transitions at lower levels of socio-economic development. There is fairly wide variation in the fertility rates at which these transitions end; some countries stabilise at fertility rates above the replacement rate of 2.1, and a few at below replacement. There does not seem to be any kind of automatic convergence of fertility at the replacement level, and high levels of socio-economic development seem to be required to reach replacement.

Death Rates and Mortality

The *crude death rate* is the number of deaths over a given period divided by the person-years lived by the population over that period. It is expressed as number of deaths per 1,000 population. *Life expectancy* is the average number of years of life expected by a hypothetical cohort of individuals who would be subject during all their lives to the mortality rates of a given period. It is expressed as years.

In order to illustrate this point, some important notation must be made:

e_x is the number of additional years of life that can be expected for a person of age x . For example, e_0 is life expectancy at birth, e_{60} is the life expectancy at age 60; q_y is the mortality risk between the ages of y and $y+x$. For example, the *adult mortality rate*, which is the probability that a 15-year-old will die before reaching the age of 60, is denoted by ${}_{45}q_{15}$. The *child mortality rate*, which is the risk of dying before the age of 5, is ${}_5q_0$, and the *infant mortality rate*, which is the risk of dying before the age of 1, is ${}_1q_0$; and The *adult survival rate* is the probability that a 15-year-old will reach the age of 60 alive, and is given by 1 minus the adult mortality rate or $1 - {}_{45}q_{15}$.

A *cohort* is a group of people in a population that are connected by some event. For example, a *birth cohort* is a group of people who are born in the same year. A population's 1970 birth cohort consists of all the people in the population who were born in 1970. A *baby boom cohort* refers to those members of a population who were born subsequent to the mortality transition and prior to the fertility transition. This baby boom cohort is larger than both the birth cohorts that preceded the mortality transition, and the birth cohorts that succeeded the fertility transition.

Population aging is the process whereby the median age of the population rises, as a result of the demographic transition. In the initial stages of the mortality transition, reductions in mortality occur disproportionately among the young, thus lowering the age of the population. As the mortality transition progresses, however, mortality among adults and the elderly decline significantly as well. Thus, as the youth cohort ages, it can also expect to live longer since it experiences lower adult and elderly mortality, contributing to population aging. Furthermore, as the fertility transition starts, the number of young people in the population declines, further contributing to population aging.

The *rate of natural increase*, defined above, is also equal to the crude birth rate minus the crude death rate.

The demographic transition theory claims that these two transitions, the mortality transition and the fertility transition, are not independent but rather causally linked, and that this causal link is a critical explanator of population dynamics over the past two centuries, and certainly for at least the next century. The broad idea is that the mortality transition, which usually happens first, either causes or is part of a broad combination of factors that jointly cause a subsequent fertility transition. How does the mortality transition lead to the fertility transition? The following section outline the specific pathways whereby mortality, socio-economic development and changes in cultural norms are hypothesised to affect fertility.

The first mechanism exists through reproductive physiology. It is a fact of this physiology that the death of very young infants results in a cessation of breastfeeding and a return to ovulation. Prior to a mortality transition, high infant mortality results in relatively earlier return to ovulation, and therefore higher likelihood of subsequent pregnancy. But when infant mortality declines, the return to ovulation is delayed and fertility declines. Grummer-Strawn *et al.* (1998) in a cross country study found that the median birth interval is 60 per cent longer if a child lives than if it dies.

The second broad mechanism has to do with the increased costs and reduced benefits of children. Having children is expensive in terms of the burdens of time, care, and expenditure for food, education and health. Even holding the costs of having children constant, mortality decline concentrated among the young implies that a given number of live births results in a higher number of children. This raises the financial burden of a given level of fertility, and over time, households will respond to this burden by reducing the number of live births.

In addition, as societies modernise, the costs of children do not just stay constant, but rise. Economic theories of fertility emphasise two mechanisms for this. According to Becker (1960), raising children requires intensive investments of time, particularly of women's time. As development proceeds, and in particular as women's education, wages and labour market opportunities increase, the relative attractiveness of having children decreases relative to working for a wage. As economists say, there is a substitution effect away from children since their opportunity costs become higher. Becker and Lewis (1973) argue that as incomes grow, parents wish to raise their expenditures on children but accomplish this by spending more per child rather than by having more children. Thus parental demand for child "quality" rises while demand for child "quantity" falls.

As societies modernise, some benefits of having children diminish. For example, urbanisation and the shift from agriculture to manufacturing reduce the value of children as farm labour. The development of public pensions and health systems reduces the value of children as sources of retirement or pension support and health

care. Technological progress and family planning programmes make contraception cheaper and more easily accessible.

Another mechanism, emphasised by sociologists and demographers rather than economists, is ideational change (Bongaarts and Watkins, 1996; Caldwell, 2001; Cleland and Wilson, 1987). According to this theory, high fertility in pretransitional societies is in part a function of social norms that encourage large families and discourage deliberate fertility control aimed at reducing family size. Thus, even if socio-economic development is causing a decline in desired family sizes, actual family sizes are unable to respond to such desires because they are constrained by social norms. After a certain threshold level of development, however, the pressures for reducing fertility gain sufficient strength and a few innovators, usually the wealthier, better educated and urbanised, adopt contraception. Once these innovators take the first step, new norms that are permissive of contraception begin to diffuse. And because of pent up demand for smaller family sizes, the resulting fertility declines are rapid.

A final mechanism is the contribution of the global family planning movement. According to this view, represented by Robey *et al.* (1993), high fertility reflects inadequate access to contraceptive services. Fertility declines occur in the developing countries when the forces of modernisation, including the declining mortality rates among the young, cause the desired number of children to decline, and the family planning movement allows for the diffusion of family planning technologies to allow households to implement their desired fertility levels.

Given these multiple hypothesised mechanisms, how can we decide which ones exist and which do not? The fundamental problem, as stated earlier, is the difficulty with demonstrating causation with respect to large scale historical processes. Traditional causal inference requires that if we wish to test for a causal effect of mortality decline upon fertility, we need to be able to find what is referred to as “exogenous” variation in mortality rates. That is, we need to find some underlying determinant of mortality – call this underlying determinant *Z* – that is not also an underlying determinant of fertility, and that is not also correlated with any other underlying determinant of fertility that we cannot control for or adequately measure. If we find such a *Z*, then variations induced by *Z* in mortality are genuinely exogenous variations in mortality that are independent of any kind of process whereby mortality and fertility are jointly determined, or whereby fertility has an impact on mortality. Any correlation between fertility and such exogenous variations in mortality can then be identified as a causal effect of mortality on fertility.

This standard of proof is remarkably high. It implies that it is erroneous to interpret correlation as causation, and that it is equally erroneous to conclude from the fact that some event precedes another that the preceding event causes the succeeding one. For example, if the same historical forces affect mortality and fertility, but affect mortality faster, then we would observe a strong correlation between

mortality decline and subsequent fertility decline. But it would be naive to conclude from this observed pattern that the former causes the latter since by assumption they are caused by the same underlying historical processes. In fact, this example frames what Cleland (2001) states to be the fundamental theoretical challenge facing the demographic transition: does the mortality transition cause the fertility transition, which was Davis' (1963) view and is also the traditional demographic transition view, or are both transitions the effects of some broader or deeper historical process like development or modernisation, which was closer to Notestein's (1953) view.

The problem is, satisfying the traditional standard of causal inference is difficult if not often impossible to achieve when the processes involved are long-term, global in scope, involve concepts that are not easily measurable, and complex. It is not easy to find some underlying determinant *Z* that affects mortality but does not also likewise affect fertility, or is not also likewise correlated with other determinants of fertility, or is not also affected by fertility. All the major determinants of mortality, such as socio-economic development, public health improvements, improved nutrition, and so on, are also likely to have an impact on fertility, or be associated with other determinants of fertility. This implies that high quality positive proof of the existence of particular causal mechanisms or pathways is scarce.

And yet it is also dangerous to be too sceptical. To say that we have not proved many of our hypotheses to be true is not the same as saying that we have conclusively proved them to be false. Certainly we would need to exert effort in sharpening our conceptual analysis and improving our empirical measures of complex concepts such as institutions or norms or public health knowledge or "women's literacy". But we might also reasonably believe that the fully rigorous standard will never be met for the bulk of our hypotheses since history is not so obliging as to provide us with all the exogenous variations we need to test our theories.

The more appropriate response may be to hold that these theories, while not demonstrated to be true, nevertheless remain intuitively plausible and give a coherent unifying account of what would otherwise be a jumbled mass of varied experiences of countries experiencing the fertility decline. This position is stated most forcefully by Cleland (2001). His view actually echoes the original Davis (1963) view: that the mortality transition is a necessary and sufficient cause of the fertility transition. He argues that the remarkable fact about all countries that have undergone the fertility transition is that they share very few background or prior characteristics *other* than the fact that they shared prior mortality transitions. If we abstract away from the fact that these countries all had mortality transitions, we would find that they have taken very heterogeneous paths towards their fertility transitions. Cleland states that:

The most striking feature of the fertility transition of the past 40 years is that an essentially similar behavioural change (i.e., limitation of births by newly developed techniques of contraception and abortion) has taken in root in diverse economic, social, and cultural conditions over a relatively short time.

This diversity encompasses material standards of living, degrees of income inequality, dominant modes of production, levels of school enrolment and adult literacy, the position of women in public life, family systems, religious beliefs, systems of government, and government population policy. (Cleland, 2001:78).

Thus, he argues that while fertility declines in East Asia were accompanied by rapid improvements in education and income growth, fertility declines in Eastern and Southern Africa were accompanied by declining enrolments and stagnant incomes. Fertility transitions occurred at high levels of standards of living in the Philippines and many Arab states, but at low levels of standards of living in Egypt, Nepal and Bangladesh. Transitions occurred in societies that engaged with the global economy (the East Asian countries) as well as those that were isolationist (North Korea, Vietnam, Myanmar). They have also occurred in societies with varying government support for family planning from strongly supportive (China, India, Indonesia, Bangladesh) to strongly unsupportive (Saudi Arabia, Mongolia). Given the heterogeneous background characteristics of countries experiencing the transition, it is reasonable and parsimonious to conclude that the one background characteristic that is shared, that is a prior mortality transition, is what caused the fertility decline.

Migration

People are not rooted to one place. They tend to move across boundaries in both directions, searching for better opportunities or escaping from conflict and other misfortune. The *net migration rate* is the number of immigrants minus the number of emigrants over a period, divided by the person-years lived by the population of the receiving country over that period. It is expressed as net number of migrants per 1,000 population. The *net number of migrants* is the number of immigrants minus the number of emigrants. It is expressed as thousands.

Migration is driven primarily by differences between countries and the desire of people to take advantage of these differences to improve their lives. The most important of these are differences in income, technology and age structure. As Pritchett (2003) states, in the early nineteenth century, the world was almost uniformly poor, and material wellbeing did not much vary across political boundaries, but today these variations are vast:

Bourguignon and Morrison (2002) estimate that in 1820 only about ten percent of the differences in incomes among all individuals in the world was due to differences in average incomes across countries. This has shown a steady increase and today over 60 percent of the inequality in the world is because of differences in incomes across countries. (Pritchett, p. 6).

In addition, the wage gaps that gave rise to the era of great migration from Europe to the lands of recent settlement in the late nineteenth century seem small relative to the wage gaps that currently exist between migration partners:

The wage ratios between Japan and Vietnam (9.1) or the UK and Kenya (7.2) or the USA and Guatemala (6.1) are substantially larger today than the historical ratios between the mass senders and the USA (Ireland, 2.3; Sweden, 4.1). (Pritchett, p. 7).

The traditional theory of economic growth (Solow, 1956) predicted convergence, that is, that poor countries will tend to grow faster than rich countries and catch up with them. This would reduce the wage and income gaps and therefore migration pressures. Yet, this has not occurred. Rather, Pritchett (1997) argues that convergence only occurs among the developed countries, and that divergence is at least as good an explanation of the differences in economic performance between developed and developing countries, and within the developing countries themselves. The persistence of wage and income gaps implies that economic incentives for migration are likely to remain high.

The second important difference is technological. Developed country workforces are more educated and have higher human capital than those of developing countries, reflecting the greater role of human capital in their technologies. Such workforces have little incentive to perform low-skilled work such as housekeeping or cleaning services, harvesting of agricultural crops, security or taxi driving, or even teaching at public schools. Such goods and services have two additional characteristics. They are non-tradeable (that is they have to be produced locally because you cannot import a clean bathroom) and possibilities for substitution of inputs in their production is low (there are limits to replacing low-skilled service workers with, say, machines). Developed country demand for low-skilled migrant workers exists because some goods and services consumed by developed country populations have these three characteristics: intensiveness in the use of low-skilled workers, non-tradeability and difficulty of substitution.

A final difference is demographic. We are coming to understand that there is an intimate relationship between the age structure of a population and its migration flows. Two mechanisms are important (Hatton and Williamson, 2003). First, migration propensities are especially high among young adults. Second, populations with a large share of the elderly require the inflow of adult migrants to prevent rising dependency ratios and support pay-as-you-go welfare systems. Labour immigration of particular occupational categories such as nurses, doctors and caregivers also satisfies the growing health services needs of aging populations. Because the demographic transition occurred first among the developed countries, and only afterwards among the developing countries, the elderly-rich phase of the former is coinciding with the adult-rich phase of the latter. The pull from the developed countries is coinciding with the push from the developing countries. While we might expect age structures across countries to converge over the course of the twenty-first century, reducing the demographic pressures for migration (Malmberg, 2004), these demographic disparities are likely to exist for at least a few decades more.

Between 1975 and 2000, the number of international migrants, defined by the UN as persons living outside their country of birth or citizenship, doubled to 175 million (Martin, 2004). It is not easy to predict what the future of migration will be. Some trends, including job outsourcing, trade liberalisation and age structure convergence across countries, might reduce migration pressures. Yet, on the whole, the disparities in income, technology and age structure are likely to remain with us for at least the next few decades, and technological and cost barriers to movement are likely to continue to decline, so it is likely that pressures for migration will remain high, at least over the next half century.

As the WPP (UN, 2005) notes, most international migration in Africa occurs across countries within Africa, and therefore shows up in country-level data, but not continent-level data. The most important migratory outflows from Africa are from Northern Africa to Europe and to Western Asian oil producers, as well as from sub-Saharan Africa to Europe, Australia, Canada and the United States.

Projections, Data and Models

Demographic data are critical to understanding societies and designing policies, and yet the considerable difficulties and obstacles to producing high quality demographic data are frequently underestimated. The data underlying demographic systems are often collected from three sources (Population Reference Bureau 2004). Censuses count the number, age and gender of all persons within well-defined areas and time periods. Civil and vital statistics systems count the number, age and gender of all persons born, dying, married and divorced within a population on an ongoing basis. Surveys collect other demographically relevant information, including educational attainment, household structure and measures of socio-economic status.

The difficulties related to all these data sources are many. In the first place, many developing countries do not have the resources, infrastructure, manpower or expertise to carry out such data collection efforts. Thus countries may hold censuses infrequently, or may not have comprehensive vital registration systems, so that one or more of these three traditional data sources is not available. According to the United Nations, there are 2 countries that do not have census or demographic data sources after 1975 and 13 countries that do not have such data after 1985. On the other hand, about 121 countries have some types of demographic data after 1995 (UN, 2005), but 32 countries do not have data after that year. Some progress has been made in the past few decades with respect to data collection in developing countries. This has occurred through the increasing collaboration and sharing of expertise between the United Nations' Statistics Division and developing countries' census and statistics offices. Where such fundamental census data are missing, the UN must resort to indirect estimation techniques, in extreme cases making inferences using data not on the countries themselves but from adjacent countries facing roughly the same demographic and socio-economic realities.

Demographic data collection in the developing countries has also been advanced by the MEASURE Demographic and Health Surveys (DHS) project, which has since the mid 1980s collected demographic data in over 200 surveys in 75 developing countries by drawing large nationally representative samples of women of reproductive age in order to obtain information on fertility, family planning, maternal and child health, child mortality, and more recently on topics such as HIV/AIDS, anaemia and violence against women. The success of the DHS is reflected in a relatively high percentage of countries having relatively recent information on both fertility and child mortality. The WPP (UN, 2005) estimates that 178 out of 192 countries had post-1995 data on fertility – including coverage of about 81 per cent of African populations – and 186 countries had post-1995 data on child mortality.

The most serious data shortfalls are in the area of adult mortality and international migration. The WPP (UN, 2005) estimates that adult mortality data were lacking or of insufficient quality for 91 per cent of Africans on a population basis. This means that UN estimates of life expectancy at birth should not be interpreted as being based on real data on age specific mortality rates through the full life cycle. Rather, they are computed on the basis of child and infant mortality data supplemented by demographic modelling techniques and data from model life tables. The scarcity of adult mortality data is made especially acute by the HIV/AIDS epidemic, wars and strife, accidents and injuries, all of which have profound effects on adult mortality, particularly in Africa. The second area of data collection concern is international migration where collection efforts are widely viewed as inadequate. In practice, estimates of net international migration are obtained as residuals: they are measured so as to make measures of population change and rates of natural increase consistent across periods.

Data availability is only one challenge. Even when data sources exist, their quality can be suspect. Censuses may undercount some hard to reach populations, such as groups living in remote areas. People may not know their own or their family members' ages or birthdays. Many births and deaths may occur without being recorded in vital registration systems. People may have imperfect recall about their or their family members' educational attainments, and they may not have an incentive to accurately report measures of their socio-economic status. When data are scarce, they must often be interpolated or extrapolated from existing data sources using demographic models. When multiple data sources exist, as for example when a civil and vital registration system and a DHS survey yield conflicting estimates of fertility or child mortality, such discrepancies must be reconciled. And finally, data must be rendered comparable across countries.

The major sources of publicly accessible and cross-country comparable data include the United Nations Statistics Division's *Demographic Yearbook*, which has been published annually since 1948, and the *Population and Vital Statistics Report*, issued quarterly. The United Nations Population Division publishes the biennial *World Population Prospects*, which includes demographic data from 1950 onwards

and predictions of demographic trends till 2050 while the Population Reference Bureau produces the *World Population Data Sheet*.

Although historical data on demographic processes are of great importance for policy planners, projections into the future are perhaps equally so. Each of the three fundamental concepts in the demographic equation – fertility, mortality and migration – is projected by the UN for a period of a half century.

With respect to fertility projections, the UN divides countries into three categories. High fertility countries are those that by 2005 had experienced little or no fertility decline, i.e., those that had not yet begun what is called the *fertility transition*. Medium fertility countries were those that had started their fertility transition by 2005 but whose fertility rates remained above 2.1. Low fertility countries are those whose fertility levels were below 2.1 in the year 2005. In the long run, the UN assumes that all countries will converge to a fertility rate of 1.85, although the three different groups of countries will achieve that rate on different time scales.

Each country's transition to the assumed long-run fertility rate is estimated using demographic models of fertility change over time. These models were developed using the historical experience of countries that underwent their fertility transitions from 1950 to 2000. That historical experience suggests that the transition begins slowly – usually with fertility rates above 5 – then accelerates as fertility falls below 5, and then slows down again towards the end of the transition. This basic assumption is embodied in a demographic model that can be used to predict fertility trends in all countries on the basis of past and present fertility rates. Thus, the UN projects that high fertility countries will not begin their fertility transitions until the year 2010, and will not reach the long-run fertility rate of 1.85 until 2083 at the earliest and perhaps not until after 2100. Medium fertility countries, on the other hand, are expected to reach their long-run fertility rate of 1.85 in 40–60 years from now.

As stated previously, because of the scarcity of adult mortality data, historical data on life expectancy is constructed primarily from data on infant and child mortality supplemented by demographic modelling that employs model life tables. The UN's life expectancy projections assume that life expectancy will continue to improve across all countries generally, continuing the rather remarkable reductions in mortality that the world has experienced over the past two centuries. Just as cross-country variations in fertility rationalise disaggregating countries into three groups, variations in mortality experience have rationalised distinguishing between five different rates of improvement in life expectancy from 1950 to 2000. These range from the very fast (reflecting rates of life expectancy growth in the 90th percentile of cross-country performance) and the fast (75th percentile), through medium (50th percentile), to slow (25th percentile) and very slow (10th percentile). All five regimes, however, share one common feature that is low life expectancies are associated with slow life expectancy growth similar to the historical experience of countries prior to their demographic transitions, with life expectancy growth

increasing during the early stages of the demographic transition as life expectancy reaches the years 50 to 60, and slower life expectancy growth thereafter.

The major exception to the general assumed trend in increasing life expectancy arises from the impact of the HIV/AIDS epidemic on population-level mortality. The UN explicitly makes special population projections for almost 60 countries with HIV prevalence rates of at least 1 per cent, as well as those such as the United States, Brazil, India and China where the combination of low prevalence but large populations results in large numbers of individuals with HIV. Contributing to the need for explicit consideration and modelling of the HIV epidemic is the fact that, the vast majority of AIDS mortality occurs among adults. Not only does this mortality strike at the population age group on whose mortality the data are most scarce, it also pushes the age structure of mortality in these populations away from the standard pattern of high mortality at the early and later ages and low mortality in the prime adult years that is most often reflected in standard model life tables.

The distinctive dynamics created by the HIV/AIDS epidemic leads the UN to model two separate mortality processes: the mortality caused by the epidemic itself and the mortality that occurs in the non-infected population, the latter referred to as “background mortality”. Modelling the mortality caused by the epidemic requires, as its first step, estimates of annual HIV incidence rates, that is, the probability that an uninfected individual will be infected within the time span of one year. This number is usually obtained from HIV status data of pregnant women attending antenatal clinics (ANCs). There are well known obstacles to extrapolating such incidence and prevalence numbers to non-pregnant women and to men, but the relative paucity of population-level data usually leads the UN to assume that the ANC data are broadly representative of HIV incidence and prevalence among women in general, and among men.

Projected trends in the epidemic are derived using data that are fed into a software package called the Epidemiological Programme Package (EPP) (Ghys *et al.*, 2004). This software treats a national epidemic as a combination of sub-epidemics (e.g., urban epidemics and rural epidemics), each of which can be modelled using a simple epidemic model created by the UNAIDS Reference Group on Estimates, Modelling and Projections. This model asks for some data inputs from the user – specifically population sizes and ANC prevalence rates, although more recently input data can include anti-retroviral therapy (ART) coverage rates and survival rates. These inputs are then used to estimate four quantities: the fraction of individuals who entered the at risk population at age 15 at the start of the epidemic, the probability that an interaction between an uninfected and infected individual will result in a new infection, the recruitment of people into the at-risk population, and the year that the epidemic started. The model can then use these parameter estimates and data to derive projections of the annual number of adults living with HIV, the number of susceptible and non-susceptible individuals, the number of new infections, and the number of deaths.

Projections of international migration are even more difficult because of the scarcity of migration data, the volatility of population flows, and the sensitivity of the flows to regional and national variations in socio-economic and political forces. In making its projections, the UN distinguishes between international migration and movement of refugees, and makes separate assumptions for each of these components. Refugees are generally assumed to return to their home countries within 5 to 10 years. With regard to international migration, it is simply assumed that in general, if a country has stable patterns of migration flows then those patterns would continue. Of the world's countries, about 15 do not have a history of significant inflows and outflows of persons, and so have projected net migration levels of zero. About 10 countries do not have international movement of persons other than refugees, and for these countries, net migration is projected to fall to zero sometime between 2005 and 2025. Of the remaining 167 countries, projected net migration is assumed to follow historical patterns relatively unchanged.

Research and Policy Priorities

What is the relevance of the relationship of the mortality and fertility transitions to Africa? What are the policy and research priorities that emerge from a consideration of the two transitions? The short answer is that one of the most central objectives of both research and policy is the promotion of the mortality transition, we discuss this issue first, the rather more subtle role of the fertility transition is will be discussed after this.

Sub-Saharan Africa achieved remarkable progress in life expectancy in the post World War II period, until the 1980s, with life expectancy growing by over a decade from about 40 to 51.5. Since 1980, however, life expectancy has – in stark exception to everywhere else in the world – fallen back to 48.1 years in 2005. This is largely due to the AIDS pandemic, although the contribution of political instability, war, conflict, other infectious diseases, accidents and injuries should not be ignored. According to the UNWPP, these factors have set back mortality decline by 25 years, so it is not until 2010–2015 the mortality predicted to go back to the 1985–1990 levels.

Reducing mortality is an end in itself. A long life is usually a precondition for the enjoyment of other goods or things of value in life: pleasurable sensations and aesthetic experiences; knowledge, self-knowledge and intellectual stimulation; the formation and enjoyment of personal relationships with loved ones, friends, family and community; the pursuit of happiness and the fulfilment of desires and preferences; and the formation, pursuit and fulfilment of life goals and commitments, whether religious, ideological, professional, personal, aesthetic or idiosyncratic. From this perspective, dying is bad, not because death is a negative experience or state of being, but rather, because it deprives us of the positive experience that is life (Nagel, 1979). Those who die young are worse off than those who die old because they have less time to experience or pursue the goods of life. This implies that measures of longevity such as life expectancy and age at death are

indicators of wellbeing. It is for this reason that life expectancy is a component of the UN's Human Development Index (HDI).

Regarding non-HIV-related causes of mortality, there remains considerable room for progress using existing technologies, including treatment for diarrhoea, respiratory infections and malaria, and research into malaria vaccines. And while issues of political stability and war are often outside the purview of standard demographic analysis, the contribution of conflict to the subcontinent's mortality rates requires that serious efforts to raise life expectancy encompass the pursuit of peace and socio-political order.

What about the policy stance towards the fertility transition? Whether policies that directly target fertility reductions are a high priority depends on whether one's views about fertility are more demographic or economic. Economic theories of fertility differ from demographic ones in the following sense: economic theories of fertility assume that households have reasonable control over fertility, and choose this fertility in a "rational" purposive way by adding up the costs and benefits of having more children. Demographic theories are more likely to emphasise the imperfect control that households have over their fertility, where this imperfect control may be due to social norms, inaccessibility of family planning, etc. Because of these differing theories, economists and demographers differ in their beliefs about the usefulness of family planning programmes. If demographic theories are correct, then the diffusion of family planning services could make households better off since this would allow households to bring actual fertility in line with desired fertility, and result in subsequent improvements in child health and education, with reductions in household poverty.

If economic theories are true, then compelling households to reduce their fertility against their will could be bad for households. It could be that in certain socio-economic environments, it is rational for parents to have high fertility as a means of ensuring their own (i.e., parental) old age security, even if this results in near-term household impoverishment. This would be the case if schooling is expensive and unaffordable, if children face daunting mortality risks in childhood and adulthood, if there are no financial markets in which parents can invest their retirement savings, or if there is no effective publicly provided social insurance for the elderly. In this socio-economic environment, it may be that the only way adults can provide for their own old age security is to have a large number of children who can provide for them when they are old. Thus, high fertility, although it may result in lower health and educational investments per child and in short- to medium-term household poverty, may still be the best way to assure long-term security for the households. In such an environment, desired fertility may actually be quite high, and improved access to reproductive health services may not result in lower fertility. While provision of contraceptives is helpful, it should not be seen as the primary driver of fertility reduction. Many family planning programmes have been implemented the world over, but there is scarce evidence of their effectiveness (see Anand and Morduch, 1999, for a review, but see also Schultz and Joshi, 2007, for a

noteworthy and rigorous evaluation of the successful Matlab programme). More likely, the need is to address the underlying socio-economic conditions that make high fertility rational. If this economic account is true, then the more appropriate policy is not to target fertility reductions themselves, but rather to address the background factors that make high fertility attractive. The policy priorities should be issues not directly related to fertility such as: the promotion of high quality and affordable schooling, improving the quality of publicly provided old age security, and improving access to private vehicles for wealth accumulation and retirement savings.

References

- Anand, S. and J. Morduch. 1999. "Poverty and the population problem". In Massimo Livi-Bacci and Gustavo de Santis, eds. *Population and Poverty in Developing Countries*. Oxford: Oxford University Press.
- Becker, G. 1960. "An economic analysis of fertility". In NBER, eds, *Demographic and Economic Change in Developing Countries*. Princeton: Princeton University Press.
- Becker, G. and H. Lewis. 1973. "On the interaction between quantity and quality of children". *Journal of Political Economy*, 81: S279–88.
- Becker, G. and H. Lewis. 1973. "On the interaction between quantity and quality of children". *Journal of Political Economy*, 81: S279–88.
- Bloom, D., D. Canning and J. Sevilla. 2002. *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*. Santa Monica, California: RAND, MR-1274.
- Bongaarts, J. 2002. "The end of the fertility transition in the developing world". Policy Working Paper No. 161. Population Research Council, Washington, D.C.
- Bongaarts, J., and E. Johansson. 2002. "Future trends in contraceptive prevalence and method mix in the developing world". *Studies in Family Planning*, 33 (1): 24–36.
- Bongaarts, J., and S. Watkins. 1996. "Social interactions and contemporary fertility transitions". *Population and Development Review*, 22 (4): 639–82.
- Boserup, E. 1981. *Population and Technological Change: A Study of Long-Term Trends*. Chicago: University of Chicago Press.
- Bourguignon, F. and C. Morrison. 2002. "Inequality among world citizens: 1820–1992". *American Economic Review*, 92 (4): 727–44.
- Caldwell, J. 2000. "Demography: scope, perspectives, and theory". Downloaded on 6 November 2006 from <http://cph.georgetown.edu/Conference/papers/Caldwell.pdf>.
- Caldwell, John C. 2001. "The globalisation of fertility behavior". In *Global Fertility Transition*, in R. Bulatao and J. Casterline, eds., *Population and Development Review*, Supplement to Vol. 27, pp. 93–115. New York: Population Council.
- Cleland, J. 2001. "The effects of improved survival on fertility: A reassessment". *Population and Development Review*, 27, Supplement: Global fertility transition: 60–92.

- Cleland, John and Chris Wilson. 1987. "Demand theories of the fertility transition: An iconoclastic view". *Population Studies*, 41: 5–30.
- Coale, A., and E. Hoover. 1958. *Population Growth and Economic Development in Low Income Countries: A Case Study of India's Prospects*. Princeton: Princeton University Press.
- Coale, Ansley J. and Roy Treadway. 1986. "A summary of the changing distribution of overall fertility, marital fertility, and the proportion married in the provinces of Europe". In Ansley J. Coale and Susan Cotts Watkins, eds., *The Decline of Fertility in Europe*, pp. 31–181. Princeton: Princeton University Press.
- Cutler, D., A. Deaton and A. Lleras-Muney. 2005. "The determinants of mortality". *Journal of Economic Perspectives*, 20 (3): 97–120.
- Davis, Kingsley. 1963. "The theory of change and response in modern demographic history". *Population Index*, 29: 345–66.
- Dyson, T. and Murphy, M. 1985. "The onset of fertility transition". *Population and Development Review*, 11: 399–440.
- Ehrlich, P. 1968. *The Population Bomb*. New York: Ballantine.
- Fogel, R. 1994. "Economic growth, population theory, and physiology: The bearing of long-term processes on the making of economic policy". *American Economic Review*, 84 (3, June): 369–95.
- Fogel, R. 1997. "New findings on secular trends in nutrition and mortality: Some implications for population theory". Chapter 3 in M.R. Rosenzweig and O. Stark, eds., *Handbook of Population and Family Economics*. San Diego: Elsevier Science BV.
- Fogel, R. 2004. *The Escape from Hunger and Premature Death, 1700–2100*, Cambridge: Cambridge University Press.
- Ghys, P., T. Brown, N. Grassly, G. Garnett, N. Stanecki, J. Stover and B. Walker. 2004. "The UNAIDS estimation and projection package: A software package to estimate and project national HIV epidemics". *Sexually Transmitted Infections*, 80: i5–i9.
- Grummer-Strawn, L., P. Stupp and Z. Mei. 1998. "Effect of a child's death on birth-spacing: A cross-national analysis". In M.R. Montgomery and B. Cohen, eds., *From Death to Birth: Mortality Decline and Reproductive Change*. Washington, D.C.: National Academy Press.
- Hatton, T. and J. Williamson. 2003. *What Fundamentals Drive World Migration?* WIDER Discussion Paper No. 023. World Institute for Development Economics Research, Helsinki.
- Haupt, A. and T. Kane. 1997. *Population Handbook*, 4th edition. Washington, D.C.: Population Reference Bureau.
- Kuznets, S. 1967. "Population and economic growth". *Proceedings of the American Philosophical Society*, 111: 170–93.

- Malmberg, B. 2004. "A boom and bust of net migration: A 40-year forecast". In J. Tamas and K. Palme, eds., *Global Migration Regimes*. Research in Migration and Ethnic Relations Series. Burlington, Vermont: Ashgate Publishing Company.
- Malthus, T. 1959. *Population: The First Essay*. Ann Arbor: University of Michigan Press.
- Martin, P. 2004. *Population and Migration: Summary of Copenhagen Consensus Challenge Paper*. Copenhagen Consensus 2004.
- McKeown, T. 1976. *The Modern Rise of Population*. New York: Academic Press.
- Nagel, T. 1979. *Mortal Questions*. Cambridge: Cambridge University Press.
- Notestein, F.W. 1953. "Economic problems of population change". In *Proceedings of the Eighth International Conference of Agricultural Economists*, pp. 13–31. New York: Oxford University Press.
- Oster, E. 2005. "Hepatitis B and the case of the missing women". *Journal of Political Economy* 113 (6): 1163–216.
- Population Reference Bureau. 2004. *Population Handbook*, 5th edition. Washington, D.C.: Population Reference Bureau.
- Preston, S. 1978. *The Effects of Infant and Child Mortality on Fertility*. New York: Academic Press.
- Pritchett, L. 1997. "Divergence, big time". *Journal of Economic Perspectives*, 11 (3): 3–17.
- Pritchett, L. 2003. "The future of migration: Irresistible forces meet immovable ideas". Mimeo. Downloaded on 16 February 2009 from: http://ksghome.harvard.edu/~lpritch.academic.ksg/future_talk.doc.
- Pritchett, L. 2006. *Let Their People Come: Breaking the Gridlock on Global Labor Mobility*. Baltimore: Brookings Institution Press.
- Robey, B., S. Rutstein and L. Morris. 1993. "The fertility decline in developing countries". *Scientific American*, 269 (6, December): 60–6.
- Salomon, J., D. Hogan, J. Stover, K. Stanecki, N. Walker, P. Ghys and B. Schwartlander. 2005. "Integrating HIV prevention and treatment: From slogans to impact". *PLoS Medicine*, 2 (1): e16 doi:10.1371/journal.pmed.0020016.
- Schultz, T.P. and S. Joshi. 2007. "Family Planning as an Investment in Development: Evaluation of a Program's Consequences in Matlab, Bangladesh". Discussion Paper No. 951. Yale Economic Growth Center, New Haven, Connecticut.
- Sen, A. 1990. "More than 100 million women are missing". *New York Review of Books*, 20 December 1990, vol. 37, number 20.
- Simon, J. 1998. *The Ultimate Resource 2*. Princeton, N.J.: Princeton University Press.
- Solow, R. 1956. "A contribution to the theory of economic growth". *Quarterly Journal of Economics*, 70: 65–94.
- United Nations. 2005. *World Population Prospects: The 2004 Revision*. Volume III: Analytical Report. New York: United Nations Population Division.

The Demand for Reproductive Health Services: Frameworks of Analysis

Olu Ajakaiye and Germano Mwabu

Like other welfare indicators, reproductive health is an outcome of consumption, in this consumption of both reproductive health care and other goods and services. In many developing countries, the availability as well as the consumption of reproductive health services is limited by a combination of economic, social and technological factors. As a consequence, low-income countries, especially in Africa have poor indicators of reproductive health such as maternal mortality ratio, infant mortality and total fertility rates. There is need to find ways of expanding the provision and consumption of reproductive health services in sub-Saharan Africa and to improve the general health of the population in the region, which currently remains low mainly because essential reproductive health care is lacking. For the purposes of this chapter, the key components of reproductive health care include:

Family planning information and services; Safe pregnancy and delivery services; Prenatal and postnatal care; Post-abortion care, in the event of abortion complications; Prevention and treatment of sexually transmitted infections, including HIV/AIDS; Information and counselling on sexuality; Elimination of harmful practices such as genital mutilation and forced marriage.

Reproductive Health Services – Categories and Policy Questions

Consistent with the literature, the reproductive health services itemised above may be grouped into three categories: market commodities, behaviours, and information. The category of reproductive health care that falls under market commodities includes immunisation of mothers against tetanus, immunisations of newborns, medical treatment and diet supplementation during pregnancy, family planning products and services, and infrastructural facilities, such as antenatal as well as postnatal clinics. Examples of individual behaviours that promote reproductive health include early initiation of prenatal care, exercising, and restraints from unhealthy practices such as smoking or drinking during pregnancy. The informational elements of reproductive health care include:

Knowledge about one's current health status as obtained, for example, through medical check-up and routine antenatal screening; Knowledge about the factors that

promote health as acquired through counselling on nutrition, HIV/AIDS, family planning, and sexually transmitted diseases; Knowledge about types of reproductive health and other services available in local health facilities, as well as best practices during pregnancy – information that can be transmitted during, for example, routine immunisation sessions.

The policies that increase the availability of reproductive health services act on the supply-side of the market for these services, while the policies that increase their consumption act on the demand-side. Both sorts of policies need to be implemented to improve the reproductive health of the population. However, while the availability of reproductive health services and commodities is a necessary condition for better health, it is by no means sufficient. Reproductive health products and services must be used in order for them to improve health. Thus, an understanding of the demand-side of reproductive health care markets is key to the design and implementation of policies that enhance the health of mothers and newborns. Underlying the demand frameworks developed in this chapter is the assumption that reproductive health services are available. The following are the demand-side questions that need to be answered to generate the information required to fully and efficiently utilise reproductive health services:

Which of the existing reproductive health services and products are the households using and why; What determines the intensity of usage of particular services and commodities and their intra-household allocations; What types of information do households need in order to make informed decisions about reproductive health care; What kinds of household behaviours need to be promoted in order to enhance maternal and child health?

The questions raised above relate to the consumption of inputs that enhance reproductive health. As in any demand situation, the utilisation of these inputs is constrained by market and non-market environments. The market environment includes the availability of reproductive health inputs and their prices, and household income and how it is shared among household members. The non-market environment comprises the household residence in a rural or an urban setting, personal characteristics of household members, such as age, education and health status, and the information people possess about the quality of reproductive health inputs.

The purpose of demand analysis, is to understand the types of policies that need to be implemented to increase all forms of health care consumption, reproductive health care included, in order to improve health. In much of the general health economics demand literature, the connection between health consumption and health production is only implied, but is not explicitly made (Akin, Griffin, Guilkey and Popkin, 1986; Akin, Guilkey and McIntosh, 1998; Gertler and van der Gaag, 1990). This chapter contributes to the existing literature by explicitly linking health care consumption to health production with a focus on reproductive health in low-income countries. Like general health, reproductive health is the complete well-

being of persons at particular *life cycles*, and not merely the absence of disease or infirmity among such individuals. Examples of such individuals include men and women of reproductive age, infants, and children. The bulk of reproductive health services in all countries are typically targeted to pregnant women, newborn babies and children.

Demand for Reproductive Health Inputs

We use a slightly modified version of a model by Rosenzweig and Schultz (1982) in which health is embedded in a utility maximising behaviour of an agent, e.g., a mother, a father or any other household member. The model is summarised in Mwabu (2008 and 2009) and its applications are highlighted in Strauss and Thomas (2008). The Rosenzweig–Schultz one-period utility function is of the form:

$$U = U(X, Y, H) \quad (1)$$

where:

X = a health neutral good, i.e., a commodity that yields utility, U , to an individual but has no direct effect on the reproductive health status of a person; an example of such a good is clothing.

Y = a health-related good or behaviour that yields utility to an individual and also affects reproductive health, e.g., smoking, alcohol consumption or preventive health activities.

H = reproductive health status of an individual.

The reproductive health production function is given by

$$H = F(Y, Z, \mu) \quad (2)$$

where:

Z = purchased market inputs such as medical care that affect health directly.

μ = the component of health due either to genetic or environmental conditions uninfluenced by behaviour.

An individual maximises (1) given (2) subject to the budget constraint given by Equation 3:

$$I = XP_x + YP_y + ZP_z \quad (3)$$

where I is exogenous income; P_x , P_y , P_μ are, respectively, the prices of the health-neutral good, X (such as clothing), health-related consumer good, Y (such as quitting smoking) and health investment good, Z (such as immunisation). Notice from equations 1 and 2 that the health investment good is purchased only for the purpose of improving reproductive health so that it enters an individual's utility function only through H .

Equation 2 describes an individual's production of health. The health production function has the property that it is embedded in the constrained utility maximisation

behaviour (equations 1 and 3). Expressions 1–3 can be manipulated to yield health input demand functions of the form:

$$X = D_x (P_x, P_y, P_z, I, \mu) \quad (4a)$$

$$Y = D_y (P_x, P_y, P_z, I, \mu) \quad (4b)$$

$$Z = D_z (P_x, P_y, P_z, I, \mu) \quad (4c)$$

The effects of changes in prices of the three goods on health can be derived from equations 4a– 4c since from Equation 2, a change in health can be expressed as:

$$dH = F_y \bullet dY + F_z \bullet dZ + F_\mu \bullet d\mu \quad (5)$$

where F_y, F_z, F_μ are marginal products of health inputs Y, Z and μ , respectively (see Equation 2).

From the Equation 2, the change in health can be related to changes in respective prices of health inputs as follows:

$$dH/dP_x = F_y \bullet dY/dP_x + F_z \bullet dZ/dP_x + F_\mu \bullet d\mu/dP_x \quad (6a)$$

$$dH/dP_y = F_y \bullet dY/dP_y + F_z \bullet dZ/dP_y + F_\mu \bullet d\mu/dP_y \quad (6b)$$

$$dH/dP_z = F_y \bullet dY/dP_z + F_z \bullet dZ/dP_z + F_\mu \bullet d\mu/dP_z \quad (6c)$$

where $d\mu/dP_i = 0$, for $i = x, y, z$ so that in Equation 6, the terms $F_\mu(.) = 0$, since μ is a random variable unrelated to commodity prices.

Effects of Prices on Reproductive Health Demands

The expressions given above reveal that commodity prices are correlated with the health status of an individual, i.e., a child or an adult. Specifically, the signs and sizes of effects of commodity prices on health depend on (a) the magnitudes of changes in demand for health inputs following price changes and (b) the sizes of the marginal products of health inputs. It is interesting to observe from Equation 6a, that changes in prices of health-neutral goods also affect reproductive health via the budget constraint.

The effects of commodity prices on reproductive health (dH/dP_i for $i = x, y, z$) depend on several factors. The first factor is the magnitude of the change in the demand for a reproductive health input following a price change (i.e., dY/dP_i or dZ/dP_i for $i = x, y, z$). The second factor is the magnitude or sign of the marginal product of that health input (F_i for $i = x, y, z$). The change in price of the health-neutral good (X) affects reproductive health status indirectly through the budget constraint. Moreover, although a change in price of good Y might be associated with an improvement in reproductive health ($F_y \bullet dY/dP_y > 0$), the effect of the same change on demand for other goods could worsen reproductive health ($F_z \bullet dZ/dP_y < 0$). Thus, the overall impact of own and cross price effects on reproductive health is uncertain. These cross-price effects are absent in demands for reproductive health that are not linked to health production.

It is clear from equations 6.1–6.3 that the demand effect of own price of Z can be expressed as $dZ/dP_z = (dH/dP_z - F_y \bullet dY/dP_z - F_\mu \bullet d\mu/dP_z)/F_z$, which reduces to $(dH/dP_z - F_y \bullet dY/dP_z)/F_z$, because $F_\mu \bullet d\mu/dP_z = 0$. The term $(F_y \bullet dY/dP_z)$ is the change in reproductive health status owing to a change in usage of a substitute or a complementary health input, Y , following the change in the price of input Z . The difference term, i.e., $(dH/dP_z - F_y \bullet dY/dP_z)$, is the change in reproductive health status resulting from the use of Z following the change in its price.

Thus, the ratio of the change in reproductive health status to the marginal product of Z , i.e., $[(dH/dP_z - F_y \bullet dY/dP_z)/F_z]$, represents the additional quantity of reproductive health service, Z , that is demanded due to a unit change in its price so that for the entire price change, we have the expression, $dZ = [dP_z \bullet (dH/dP_z - F_y \bullet dY/dP_z)/F_z]$. This expression is of policy interest because it reveals that in order to predict the change in utilisation of the reproductive health service, dZ , following a change in its price, information on marginal products of all reproductive health inputs (F_y and F_z) is required. On its own, however, this expression could convey the misleading information that the demand for reproductive health services is motivated solely by the desire to improve health. Equation 1 deceptively indicates that the magnitudes of marginal utilities of reproductive health services determine observed demands for these services. This issues involved here are taken up next.

Consumer Behaviour, Marginal Products and Marginal Utilities of Reproductive Health Services

Equations 6a–6c depict the role of reproductive health care as an input into health production (Equation 2) while Equation 1 depicts its role as a consumer good. As a consumer good, reproductive health care yields utility and as an input it improves health. The marginal utilities of Y and Z are available from Equation 1, whereas their respective marginal products can be derived from Equation 2. Thus, it can be observed from expressions 1 and 6 that a mother would be willing to consume a commodity that has a prospect of harming health (e.g., smoking), because it yields utility. Similarly, a person would be willing to undertake medical treatment that yields disutility if it is expected to improve health. These and other commonly observed behaviours in health care markets are explained by the Rosenzweig–Schultz model.

Estimation of Reproductive Health Care Demands and Reproductive Health Production Technologies

Policy makers need to know the parameters of reproductive health care demand functions and the associated health production technologies to plan for the provision and utilisation of family health services and related goods. Reproductive health services planning is required to achieve commonly agreed health objectives, such as the Millennium Development Goal 5, Target 6, of reducing maternal mortality by three-quarters between 1990 and 2015. To obtain the information

required for planning, reproductive health technology and related input demand parameters must be estimated jointly. This estimation is complicated by the need to identify reproductive health care demand functions from reproductive health production technologies.

The first step in the estimation of a reproductive health production model is the estimation of demands for inputs into that model. In the context of Equation 2, these are demands for Y and Z . The demand for X is not of interest, except as a residual, particularly in budget share demand specifications. As inputs into reproductive health production, Y and Z are choice variables and are therefore endogenous to reproductive health. Thus, in order to obtain unbiased and consistent estimates of demand parameters for Y and Z , instrumentation of these variables is required. The instrumental variables for Y and Z are factors that can be used to predict Y and Z , without affecting reproductive health status. Equations 4a–4c indicate that exogenous income such as rent income, and prices of Y , Z and X are valid instruments. Availability of social infrastructure like roads, and access variables, such as distances or travel time to health facilities, are additional instruments (Strauss, 1986; Bound *et al.*, 1995).

Functional Forms and Specification Issues

The material presented in the following sections is an adaptation and elaboration of Mwabu (2008). As derived from Rosenzweig and Schultz (1983), the translog reproductive health production function can be written as:

$$\ln(H) = \gamma + \frac{1}{2} \sum_i \sum_j \beta_{ij} \ln(Y_i) \ln(Y_j) + \sum_i \beta_i \ln(Y_i) + \delta \cdot Z + \mu + \epsilon \quad (7)$$

where the term $\ln$ is the natural log operator; γ , δ , β_i , and β_{ij} are technological parameters to be estimated; Y_i is health input i , with $i \neq j$; Z is a vector of other control variables such as socio-economic characteristics of households; and ϵ is a random error term.

As an alternative to the translog function, the following generalised linear reproductive health production relationship can be specified (see Diewert, 1971):

$$H = \gamma + \sum_i \sum_j \hat{\alpha}_{ij} \cdot \sum (Y_i)^{1/2} \cdot (Y_j)^{1/2} + \sum_i \hat{\alpha}_i \cdot \ln(Y_i) + \delta \cdot Z + \mu + \epsilon \quad (8)$$

where $\hat{\alpha}_{ij}$ are health effects of the interaction terms. In the case of four health inputs, the model to be estimated would have 16 interaction coefficients (including the coefficients on the square root terms). However, symmetry restrictions, i.e., $\hat{\alpha}_{ij} = \hat{\alpha}_{ji}$, considerably reduce the number of the parameters that are actually estimated. As in the case of the translog function, the generalised linear and Leontief specifications (Diewert, 1971) are very useful in providing second-order approximations to an arbitrary function at a given vector of covariates using only a minimal number of parameters, i.e., the coefficients of the interaction terms.

Since μ is unobservable, the composite error term in Equation 7 is the sum of ϵ and μ , which is potentially correlated with the independent variables (Y_i s) so that the ordinary least squares (OLS) estimates of β_i and β_{ij} parameters may be inconsistent.

In a translog, the data determine the correct mathematical form of the production technology. For example, if the estimated β_{ij} s are equal to zero, Equation 7 takes the form of a Cobb–Douglas production function. Second, the symmetry restriction, $\beta_{ij} = \beta_{ji}$, significantly reduces the number of β_{ij} parameters to be estimated.

To illustrate the usefulness of symmetry restriction, assume that there are four health inputs into a reproductive health production function. Now suppressing the Z covariates and the composite error term, Expression 7 can be rewritten out in full as:

$$\begin{aligned} \ln(H) = & \gamma + \beta_1 \bullet \ln(Y_1) + \beta_2 \bullet \ln(Y_2) + \beta_3 \bullet \ln(Y_3) + \beta_4 \bullet \ln(Y_4) + \frac{1}{2} \{ \beta_{11} \bullet \ln(Y_1) \ln(Y_1) + \\ & \beta_{12} \bullet \ln(Y_1) \ln(Y_2) + \beta_{13} \bullet \ln(Y_1) \ln(Y_3) + \beta_{14} \bullet \ln(Y_1) \ln(Y_4) \} + \frac{1}{2} \{ \beta_{21} \bullet \ln(Y_2) \ln(Y_1) + \\ & \beta_{22} \bullet \ln(Y_2) \ln(Y_2) + \beta_{23} \bullet \ln(Y_2) \ln(Y_3) + \beta_{24} \bullet \ln(Y_2) \ln(Y_4) \} + \frac{1}{2} \{ \beta_{31} \bullet \ln(Y_3) \ln(Y_1) + \\ & \beta_{32} \bullet \ln(Y_3) \ln(Y_2) + \beta_{33} \bullet \ln(Y_3) \ln(Y_3) + \beta_{34} \bullet \ln(Y_3) \ln(Y_4) \} + \frac{1}{2} \{ \beta_{41} \bullet \ln(Y_4) \ln(Y_1) + \\ & \beta_{42} \bullet \ln(Y_4) \ln(Y_2) + \beta_{43} \bullet \ln(Y_4) \ln(Y_3) + \beta_{44} \bullet \ln(Y_4) \ln(Y_4) \} \end{aligned} \quad (9)$$

From the symmetry restriction, $\beta_{ij} = \beta_{ji}$, we find

$$\begin{aligned} \beta_{12} = \beta_{21}, \beta_{13} = \beta_{31}, \beta_{14} = \beta_{41}; \\ \beta_{23} = \beta_{32}, \beta_{24} = \beta_{42}, \beta_{34} = \beta_{43}. \end{aligned}$$

Thus, ignoring the coefficients of the quadratic terms, i.e., β_{11} , β_{22} , β_{33} , and β_{44} , it can be seen from (9) that out of a total of 12 coefficients of the interaction terms, only 6 need to be estimated, namely, β_{12} , β_{13} , β_{14} , β_{23} , β_{24} , and β_{34} . It is interesting to observe that there is no need to estimate the coefficients of the *interactions* of the fourth (last) input with each of the other inputs. That is, symmetry makes unnecessary the estimation of β_{41} , β_{42} , and β_{43} . More generally, estimation of β_{ij} is not needed when i is indexing the *last* input in the interaction terms. For completeness of the example, notice from (Equation 9), that the double summation of parameters ($\sum_i \sum_j \beta_{ij}$) in Equation 7 can be fully expanded as:

Inner summation:

$$\begin{aligned} \sum_j \beta_{ij} = & (\beta_{11} + \beta_{12} + \beta_{13} + \beta_{14}); (\beta_{21} + \beta_{22} + \beta_{23} + \beta_{24}); \\ & (\beta_{31} + \beta_{32} + \beta_{33} + \beta_{34}); (\beta_{41} + \beta_{42} + \beta_{43} + \beta_{44}) \end{aligned} \quad (10a)$$

Outer summation:

$$\sum_i = \sum_j \beta_{1j} + \sum_j \beta_{2j} + \sum_j \beta_{3j} + \sum_j \beta_{4j} \quad (10b)$$

Notice that Equation 8 can be expanded similarly. As noted earlier, for (7) to simplify to a Cobb–Douglas production function, the sum in (10b) must be equal to

zero. Statistically, the sum in (10b) is equal to zero if the parameters in (10a) are jointly not different from zero. This observation is easily checked if (7) is written as

$$H = \exp(\gamma) \cdot Y_i^{\beta} \exp\left\{\left(\frac{1}{2} \Sigma_i \Sigma_j \beta_{ij} \cdot \ln(Y_i) \ln(Y_j)\right)\right\} \exp(\delta \cdot Z) \exp(\mu) \exp(\epsilon) \quad (10c)$$

where, as before, Z may contain dummy variables such as gender, race and region of residence. Equation 10 shows that the translog is an augmented form of the Cobb–Douglas function.

The above model specifications concern functional forms for continuous health input demands or for continuous health production functions. In the health economics literature, there are also examples of functional forms for demand and production functions that are discrete. That is, the dependent variables are discrete (see e.g., Gertler and van der Gaag, 1990; Strauss and Thomas, 1995; Dow, 1999; and Sahn *et al.*, 2003).

These studies discuss and apply nested and non-nested discrete choice models of health care demand using micro data. The models are appropriate for analysing multiple rather than binary choices. A nested multinomial model, for example, is appropriate if one is analysing a mother's decision either to use or not to use an immunisation service and her subsequent choice of an immunisation facility from among multiple alternatives such as government or missionary clinics. If a multinomial model is not nested, a simple version of such a model is adequate. Furthermore, binary probit and logit models are sufficient when analysis is restricted to a dichotomous choice, e.g., whether or not a mother is using family planning.

A convenient specification of a nested logit model that encompasses all the aspects discussed above is in Sahn *et al.* (2003). These authors model the selection of a health care provider, given that a person is sick. Since this is a discrete choice, the focus of the analysis is on the probability that one selects a given option. In their model, they specify five options: no care (or self-care), care at a public hospital, care at a private hospital, care at a public clinic, or care at a private clinic. Following Gertler and van der Gaag (1990), they specify an indirect utility function of the form:

$$V_j = f(y - p_j) + Q(X, Z_j) + e_j \quad (11a)$$

where $(y - p_j)$ is net income (y) after paying a price p for health care at option j ; X is a set of individual or household variables that do not vary with the discrete alternatives; and Z_j is a set of choice-specific variables. The function, $Q(X, Z_j)$, indicates the quality of alternative j , and is a function of attributes characterising the alternative, as well as those of the individual making the choice. In this specification, the quality function, $Q(X, Z_j)$, is linear in X and Z variables. The X variables include age, education, marital status, duration of illness, and household demographics. In all cases, the coefficients on these attributes vary across alternatives. In Equation (11a), the benefits obtainable from treatment at a particular facility depend on net income of an individual (signifying the quantity of the

service that can be bought) and the quality of service (indicating the efficacy or effectiveness of treatment).

To satisfy certain utility maximisation axioms (see Gertler and van der Gaag, 1990), the functional form for prices and income is usually specified as a quadratic in the logs of net income as follows:

$$f(y-p_j) = \beta_1 \delta \ln(y-p_j) + \beta_2 \delta [\ln(y-p_j)]^2 \quad (11b)$$

where the β 's are kept equal across the choice alternatives being considered. This constrains the marginal utility of income to be the same across options (see Dow, 1999).

As with all discrete choice models, the logit model in Equation (11) identifies only the difference in utilities, $V_j - V_0$, where V_0 is a reference or base utility, which in this case is utility from self-care. Specifically, the quality of self-care is set to zero. In situations where costs of care are small relative to income, the function $f(y-p_j)$ will be similar across alternatives. To simplify estimation, Sahn *et al.* (2003) work with the following approximate form of Equation 11b:

$$\begin{aligned} f(y-p_j) &= \beta_1 \delta \ln(y-p_j) + \beta_2 \delta [\ln(y-p_j)]^2 \\ &\approx \beta_1 \delta \{ \ln(y) - p_j/y \} + \beta_2 \delta \{ \ln(y)^2 - 2 \ln(y) (p_j/y) \} \end{aligned} \quad (12)$$

Both $\ln(y)$ and its square are constant across options, so that after taking the difference $V_j - V_0$, only $\beta_1(-p_j/y) - \beta_2\{2\ln(y)(p_j/y)\}$ remains, and thus the two coefficients of interest are identified. Nesting the logit choices allows estimation of the covariances between the e 's across options, which in turn allows cross-price elasticities to vary between alternatives. Sahn *et al.* (2003) specify the probability π_l that a person chooses alternative l ($l \neq j$) is given by:

$$\pi_l = \frac{\left[\exp\left(\frac{V_i}{\sigma_{j(l)}}\right) \right] \left[\sum_{i \in j(l)} \exp\left(\frac{V_i}{\sigma_{j(l)}}\right) \right]^{\left(\frac{\sigma_{j(l)}}{\tau_{k(l)}}\right)^{-1}} \left[\sum_{j \in k(l)} \left[\sum_{i \in j(l)} \exp\left(\frac{V_i}{\sigma_j}\right) \right]^{\left(\frac{\sigma_{j(l)}}{\sigma_{k(l)}}\right)} \right]^{\tau_{k(l)}}}{\sum_k \left(\sum_j \left[\sum_{i \in j} \exp\left(\frac{V_i}{\sigma_j}\right) \right]^{\left(\frac{\sigma_j}{\tau_k}\right)} \right)^{\tau_k}} \quad (13)$$

where i indexes the individual options (private hospital, etc.); j indexes the lower level nests (hospital care, or non-hospital care); and k indexes the upper level nest (no care or care). V_i is the indirect utility associated with option i ; σ_j is the inclusive value coefficient for the lower level nests; τ_k is the inclusive value coefficient for the upper level nests (the limbs); and $j(l)$ and $k(l)$ indicate the lower and upper level nests to which option l belongs.

Note that if all τ_k are constrained to one, Equation 13 reduces to one-level nested logit model if the σ_j are also one, it collapses to a multinomial logit model. Furthermore, if the choice set is binary, Equation 13 reduces to a binary logit or probit model. Notice that although Equation 13 is typically used to estimate discrete choice demands, it can also be used to analyse discrete health outcomes in a production function context. For example, the framework can be used to estimate the probability that a child will be in one of the several mutually exclusive health states after being immunised against a particular illness. In the same vein, analysis can focus on demand for reproductive health itself, as in Grossman (1972), instead of on demand for the inputs required to produce it as in Equation 4.

In Grossman's model, the demand for health (reproductive health included) is for investment and consumption purposes (see Mwabu, 2008). In the spirit of that framework, reproductive health yields direct utility to an individual, and also increases labour income through two channels. The first channel is through a reduction in sick time so that more time is available for production. The second is through the enhancement of work effort.

Estimation Issues

In order to estimate equations 7, 8 or 13, measurement of all the variables specified in these equations is required. The health outcome variable – the dependent variable, H , in Equation 7 for example – can be measured using a number of indicators, e.g., birth weight, height and body mass index.

Because of problems of endogeneity, estimation of equations 7 or 8 via the OLS yields biased results. The IV method addresses the endogeneity problem by purging the correlation between the health inputs and the overall residual in Equation 7. As can be seen from Equation 7, the overall residual consists of a white noise term and unobservable health endowments. Endogeneity is also an issue in Equation 13 and could partially be addressed using the *ivprobit* methods in STATA.

The challenge in using the IV methods is to find valid instruments for the endogenous variables. In general, local commodity prices and measures of community level infrastructure have been shown to be valid instruments for health inputs (Rosenzweig and Schultz, 1983; Strauss, 1986; Strauss and Thomas, 1995; Wooldridge, 2002).

Intra-Household Allocations

Households provide the environment in which individuals produce and consume health and other goods and services. In addition to providing members with an environment for production and consumption of private and public goods, the household also provides the mechanism for intra-household allocation of essential commodities such as health care, food, clothing and reproductive health services. This allocation mechanism is important because it determines the wellbeing of all

household members. The presentation and discussion of household models in this section draws heavily from Mwabu (2008).

The Unitary Model

In Becker's (1981) household model, commonly known as the *unitary* model, the intra-household distribution of commodities occurs automatically. The model predicts that in a household with a caring head, all members will pursue a common goal. It is Becker's (1974:1080) Rotten Kid Theorem that ensures automatic intra-household transfers. In Becker's words, "... sufficient 'love' by one member guarantees that all members act as if they loved other members as much as themselves. As it were, the amount of 'love' required in a family is economised: sufficient 'love' by one member leads all other members by 'an invisible hand' to act as if they too loved everyone".

Bergstrom (1989) provides a simple and clear exposition of the Rotten Kid Theorem. The theorem "asserts that if all family members receive gifts of money income from a benevolent household member, then even if the household does not precommit to an incentive plan for family members, it will be in the interest of selfish family members to maximise total family income" (p. 1138). Bergstrom (1989:1139–40) illustrates the theorem as follows.

Let $U(X_1, \dots, X_n)$ be the utility of an altruistic household head, where X_i ($i = 1, \dots, n$) is consumption of a private good X by household member i . Denote I_i as the income of selfish member i before any intra-household transfers occur so that total consumption expenditure of all household members on units of commodity X is equal to total household units of commodity X is equal to total household income, i.e., $\sum_i X_i = \sum_i I_i$, where price of X is unity. After the income transfers by the household head, the distribution of consumption in the household must be the one that maximises the utility of the household head subject to the restriction that $\sum_i X_i = \sum_i I_i$.

The rational head will not choose an intra-household consumption distribution that does not maximise his utility. Because the transfers are made out of total household income, consumption of each household member depends on that total income. Hence each member has an interest in maximising total household income, even at the cost of reducing one's *own* income because the head would compensate any such cost through transfers. Furthermore, any gain in personal income unwanted by the head would be similarly offset. Just as the rational head will not choose an intra-household allocation that does not maximise his utility, rational household members would not deviate from such an allocation because they know that the head would offset the income effect of their actions. Thus, the Pareto optimal intra-household consumption allocation is achieved automatically without the head having to use the transfers to enforce it. This is the intuitive proof of the theorem.

The reasons for the failure of the theorem to work as stated include problems in monitoring the behaviour of household members, information asymmetries within

the household, and problems in designing incentives that make household members accomplish the welfare programme chosen by the head. Formal analysis of these issues and additional reasons are found in Bergstrom (1989:1138). In the context of the theorem, the term “rotten” means selfish, or “not as caring about the well-being of other household members as much as the altruistic head does.” Browning *et al.* (1994:1071) distinguish between altruistic preferences where an individual derives utility from a good consumed by another (as in the case given above), and caring preferences where a person cares about the good consumed by another only insofar as it gives the other person some utility. The caring preferences have the advantage of being non-paternalistic because a person does not make transfers that are not beneficial to another.

The unitary household model predicts that household members will pool their resources and that their welfare is unaffected by the identity of the person controlling the resource allocation. These predictions are unlikely to apply in the case of vulnerable household members such as women and children.

The Collective Model

The collective model is the alternative to the unitary model in the household economics literature. The collective household model (Chiappori, 1988; Alderman *et al.*, 1995; Haddad *et al.*, 1997) is appropriate for analysing reproductive health within a household because it accounts for intra-household distribution of market and non-market goods. This model is well known in the household economics literature. Following Thomas (2000), the welfare of a household in a collective model can be written as:

$$\text{Max } W = \sum_m \tau_m U_m (L, X; A, e), m = 1, \dots, N \quad (14a)$$

Subject to:

$$pX = \sum_m (w_m(T_m - L_m) + Y_m) \quad (14b)$$

where:

W = welfare derived from total household consumption;

$\tau_m U_m (.)$ = an individual utility function, weighted by τ_m , the index of bargaining power of individual m in the allocation of consumption within the household, such that $\sum_m \tau_m$ is equal to 1;

p = a vector of commodity prices;

w = a vector of wages for all household members;

T = total household time;

Y = total non-labour income;

X = a vector of goods consumed by all household members, including medical and health care so that commodity expenditure, pX is equal to total labour and non-labour income;

L = a vector of leisure time for all household members.

In addition, A is a vector of household-level demographics such as household size, composition, and personal characteristics such as age, gender, health status and education of all household members, and e = a vector of unobserved heterogeneity in the household, such as attitudes and ability of members or more generally, efficiency parameters (Manser and Brown, 1980: 35; Mwabu, 2008).

The bargaining version of the collective model

In Expression 14a, the household maximises the weighted sum of utilities that its members derive from their own consumption bundles, given the sharing rule. There is need to clarify that (14a) is one of the ways of specifying the welfare function of the household in the context of collective decision making. An alternative specification (Manser and Brown, 1980; McElroy and Horney, 1981) in a two-person household context is

$$\text{Max } W = [U_1(L, X; A, e) - V_{01}] \bullet [U_2(L, X; A, e) - V_{02}] \quad (15)$$

where: W is household welfare; $U_1(.)$ is utility for individual 1; $V_{01} (.)$ is reservation utility for individual 1, i.e., the utility that person 1 can obtain if they are not a member of the household; $U_1 - V_{01}$ is the net benefit that person 1 gets from being a member of the household; and similarly for person 2.

Following Manser and Brown (1980: 38), and assuming an N -person household, Equation 15 can be rewritten in logarithmic form as

$$\text{Log } (W) = \sum_m \text{Log}[U_m(L, X; A, e) - V_{0m}], m = 1, \dots, N \text{ and } U_m(.) \neq V_{0m} \quad (16)$$

In Equation 16, the household maximises the *product* of net utilities of its members (rather than the *sum* of weighted utilities as in (14a)) subject to the same budget constraint (Equation 14b). Notice that Equation 16 is restricted to situations where $U_m(.) \neq V_{0m}$ to avoid taking the logarithm of zero. The bargaining power index, τ , enters the household objective function through the reservation utility (indirect utility) of the following general form:

$$V_{0m} = V_{0m}(p, w; A, \tau(\rho(\theta))) \quad (17)$$

where:

- V_{0m} = the maximum indirect utility that a household member m can attain given the market prices, p , the wage rate, w , and the individual's socio-economic characteristics, A and bargaining power within the household;
- τ = is the Pareto weight, the share of m 's utility in total household welfare, and helps aggregate personal utilities to the household level utility;
- ρ = resource sharing rule, which helps decentralise decision making within the household;
- θ = is a set of m 's options outside the household, e.g., job and marriage opportunities.

Thus in Equation 17 the term, $\tau(\rho(\theta))$, is a proxy for income that person m can command within the household, and generally reflects the person's consumption possibilities (see Mwabu, 2008, for details).

If the bargaining power index (τ) of the household member m is equal to 1, Equation 16 converges to a unitary model. This can easily be checked as follows: If $\tau_m = 1$, the net utility from being a household member for each of the other $m-1$ members is large, i.e., their reservation utilities are small because by definition they have no options outside the household or such options are of limited value.

In contrast, the reservation utility for the person with complete bargaining power ($\tau_m = 1$) is large, and therefore this individual's personal gain from household membership is small or negligible. However, there is more to this. If person m has complete bargaining power, the net gains that the other members derive from the household could *reflect* this person's preferences. That is, if the other members share person m 's preferences, then their net utilities are also m 's utilities. This is the common preferences model. However, the dominant member could also impose their own caring preferences on other household members. This is the benevolent dictator model. Notice that if the net gain of the dominant household member is negative, the individual would still remain a member, as long as the sum of net gains for all members (self included) is positive.

The separate spheres version of the collective model

Modifying Equation 16 to capture non-cooperative behaviour within the household (Chen and Woolley, 2001) can be done easily as follows:

$$\text{Log}(W) = \sum_m \tau_m \bullet \text{Log}[U_m(L, X; A, e) - V^*_{0m}], m = 1, \dots, N \text{ and } U_m(.) \neq V^*_{0m} \quad (18)$$

where: V^*_{0m} is the maximum utility that household member m gets without cooperating with other family members, conditional on being part of the family. That is, it is the utility the individual derives by acting strategically to maximise self interest, taking as given the behaviour of other household members. These are the utilities derived from what has been termed *separate spheres* of responsibilities within the household (Lundberg and Pollak, 1993).

However, since individuals in a household are presumed to care about one another, i.e., they have caring preferences (Browning *et al.*, 1994; Chen and Woolley, 2001), they also have an incentive to cooperate, particularly in the provision of household public goods. The utility level V^*_{0m} represents the minimum benefit that m would expect to get if he were to cooperate with other household members. For example, if he were to agree to contribute to a household good, such as cleaning the household compound every week, his utility under the new circumstance cannot be less than V^*_{0m} . Thus, as in Equation 16, the V^*_{0m} represents reservation utility or a point of threat to cooperation. In contrast to (16), where the threat is about divorce or quitting the household, in Equation 18 the threat is about a return to non-

cooperative behaviour (Lundberg and Pollak, 1993, 1994). Notice that as in equations 14a and 16, if the bargaining power index, τ_m , is unity, Equation 18 collapses to a unitary model.

The formulation of the welfare function in Equation 18 is best illustrated with a two-person household, consisting of a husband (m) and a wife (f). Following Chen and Woolley (2001), we assume that a household member i has the following utility function, which is separable in private good, x_i , and a household public good x^h as indicated in Equation 19.

$$W_i = U_i + U_j = [u(x_i) + v(x^h)] + s[u(x_j) + v(x^h)], \text{ for } i, j = m, f \quad (19)$$

where: W_i is the welfare of person i , a weighted sum of utilities from own consumption and consumption of j (weighted by the parameter, s) in which s is a caring parameter (the share of j 's utility in i 's total utility) so that $0 < s < 1$. Notice that if the caring parameter, s , is equal to zero, then the own utility of i , $u(x_i)$, is weighted by 1.

Chen and Woolley (2001) indicate that both m and f choose x to maximise W_i subject to a budget constraint, taking as given each other's purchases of public good, x^h . The resulting Cournot equilibrium pair of x and x^h for each spouse is associated with an optimal level of W_i^* . These net utilities are generated by a non-cooperative game within a family. Any cooperative Nash game, like joint provision of a public good, must yield at least W_i^* , $i = m, f$. Denoting W_i^* as V_{01}^* and V_{02}^* respectively (where 01 = m and 02 = f), the expression for maximisation of household-level welfare rather than of personal utilities by the spouses is:

$$\max W = [U_1(L, X; A, e) - V_{01}^*]^{\tau_1} \cdot [U_2(L, X; A, e) - V_{02}^*]^{\tau_2} \quad (20)$$

where the exponents, τ_1 and τ_2 are the bargaining power indexes of the husband and wife, respectively. This expression easily generalises to Equation 18 in the context of an N -person household. The solution to (18) is a Cournot-Nash equilibrium because it combines the non-cooperative and cooperative behaviours of Cournot and Nash games, respectively.

The caring parameter (s in Equation 19) and the Pareto weight (τ , in Equation 20) should be carefully distinguished. We start with the exposition of the caring parameter. The caring parameter, s , accounts for interdependencies of utilities of persons m and f within a household. It takes account of the fact that the utility level of person m , for example, could depend on the utility level of f , and vice versa.

The caring parameter states that that the utility of person 1 (i.e., U_1) is equal to $(1-s)u_1$ plus some fraction, s , of utility of person 2 (u_2); and conversely for person 2's utility. Person 1's utility under the caring preferences assumption can be expressed as:

$$U_1 = (1-s)u_1 + su_2 \quad (21)$$

Notice that if s is equal to zero, $U_1 = u_1$, which means that the preferences are egoistic rather than caring. In that case, an individual's utility is based solely on his or her own consumption. The extension of this example to the case of an N -person household is straightforward. In the case of an N -person household, s becomes s_{ij} , where s_{ij} is the share of utility of member j in member i 's utility, where for a given $i, j = 2, 3 \dots N-1$.

In contrast, the Pareto weight, τ , is the share of person 1 in the total utility of the household with members whose utilities are interdependent. In a two-person household, if τ_1 is equal to zero, the utility of person 1 does not matter; only that of person 2 does. This is the case of a unitary model, where person 2 acts as a dictator. This case is also easily generalizable to an N -person household. As noted earlier, the role of τ is to aggregate utilities of individuals to a *household level utility*, taking into account the bargaining power of each member. Here the role of s is to construct the *utility index of an individual*, taking into account the interdependencies of individuals within a household, as summarised by the caring parameter, s , which expresses the extent to which a particular individual's preferences are caring.

Experimental Approaches

So far, the demand frameworks described rely on survey data and regression analysis to make causal inference. That is, to measure causal effects of variables that affect reproductive health. The effect of a variable (such as tetanus immunisation) that improves reproductive health (e.g., reduces maternal mortality) can only be measured correctly if it is varying independently of reproductive health. That is, if tetanus vaccination is exogenous to maternal mortality.

The regression approach to this problem is controversial because the effects of confounding variables are difficult to isolate from the impact of the variable of interest. This particular problem arises because of measurement errors, reverse causality and omitted variables. From a technical standpoint, the problem is that the explanatory variable of interest is correlated with the disturbance term in a regression equation. Although instrumental variables are widely used to solve this problem, credible instruments are not easy to find (Bound *et al.*, 1995). The ideal solution to the problem of identifying causality in the example given above is to design an experiment, in which "treatment" and "comparison" groups are randomly assigned, say, tetanus vaccination. For example, the treatment group would be vaccinated and the comparison group would not. Measured differences in maternal mortality between the two groups would in this case be attributed to tetanus vaccination. However, ideal experiments are difficult to design (Rosenzweig and Wolpin, 2000; Culyer and Newhouse, 2000). Experimental and non-experimental methods of identifying causality are thoroughly covered in Schultz and Strauss (2008). The relatively new regression techniques for measuring causal effects in structural models, e.g., the local instrumental variable (LIV) method and the control function approach, are presented in Todd (2008).

Applications of Frameworks: Selective Illustrations

The applications presented in this section pertain only to the unitary version of the general collective household model. Because of data limitations, it is not possible to illustrate other versions of the collective model. Moreover, the unitary model is illustrated with only a few of the available specifications of demand and production functions. It is hoped that the variants of the collective model presented in this chapter, as well as the various specifications discussed therein, will guide studies on reproductive health, growth and poverty at the micro level in Africa and elsewhere.

Demand for Contraceptives and Maternal Health in Malaysia

Using a budget constraint similar to the one indicated in Equation 3, Rosenzweig and Schultz (1987) estimated the effects of contraceptives on maternal health using a two-period utility model. The models in equations 22a and 22b are helpful in interpreting the estimation results that follow:

$$\text{Max } V = \Sigma \{U(n_1, X_{1j}) + \delta U(N_j, H_j, X_{2j}; \alpha_j)\}, i=1,2 \quad (22a)$$

where:

- V = expected utility over the two time periods;
- N_1 = number of children ever born in period 1;
- X_{1j} = market goods consumed by couple j in period i ($i=1, 2$);
- δ = discount rate;
- α = household-specific taste parameter;
- $N_j = n_{1j} + n_{2j}$ (cumulative fertility) of household j over the two time periods;
- H_j = per child human capital input for couple j (e.g., educational attainment);
- s_j = per child human capital input (e.g., average years of schooling or birth weight).

Maximisation of Equation 22a subject to a budget constraint yields demand functions for fertility, human capital and market goods defined above.

The reproduction function technology of the couple (the couple's fecundity) is given by:

$$n_{ij} = n(Z_{ij}; i) + u_i + e_i, n_z < 0, n_{zz} < 0 \quad (22b)$$

where:

- Zs = fertility control inputs (i.e., contraceptives or family planning methods);
- u_j = time-invariant, couple specific component of fertility that is unaffected by the couple's behaviour;
- e_j = independently distributed disturbance term.

In Equation 22b the demand for Z (contraceptive commodities and services) is as indicated in Equation 4. Clearly, covariates Z in the reproduction function Equation 22b are endogenous. Thus, to consistently estimate their effects on fertility (n_{ij}), the use of the IV method is required. The instruments suggested in Equation 4 were used for estimation using Malaysian data (1,262 households). In Equation 22b, n_j measures of the health status of the mother. Table 3.1 presents estimation results of a linear reproduction function (Equation 22b). As argued in Section 5, a general flexible form such as the translog is the ideal form to estimate.

Table 3.1: Estimates of a linear reproduction technology of a couple's children

Variables	Estimation procedure (<i>t</i> -statistics in parentheses)	
	OLS	2SLS
<i>Endogenous variables</i>		
Pill/IUD	-0.0241 (2.77)	-0.0713 (2.02)
Condom	-0.0233 (1.43)	-0.0291 (0.38)
Ineffective methods/(100)	-0.079 (0.07)	-0.881 (0.17)
Breast feeding, in months ($\times 10^{-2}$)	-.00737 (0.6)	-0.131 (2.91)
<i>Exogenous variables</i>		
Mother's age, in months ($\times 10^{-3}$)	0.218 (0.71)	0.0418 (0.93)
Mother's age squared ($\times 10^{-6}$)	-0.631 (1.71)	-0.758 (1.52)
Constant	0.0436 (0.71)	0.134 (1.60)
<i>R</i> -squared	0.10	—
<i>F</i>	8.90	8.17

Source: Rosenzweig and Schultz (1987, Table 4, p. 174).

The 2SLS results summarised in Table 3.1 reveal the effects of contraceptives on fertility after purging their correlation with the error term. That is, after making the demand for contraceptives vary independently of fertility. In contrast, the OLS results are obtained without taking into account the endogeneity of contraceptives to fertility. The pill reduces fertility in both cases, but the IV estimate is larger than the OLS estimate. The negative coefficient on breastfeeding becomes larger and statistically significant when the endogeneity problem is removed, indicating that 2SLS is the appropriate estimation method. Notice that although the first-stage regressions (estimations of demands for contraceptives) are not shown, these are routinely reported (see Bound *et al.*, 1995). Moreover, inclusion in Equation 22b of variables that capture the control of household assets by various members of the households would yield results indicating intra-household variations in the demand for contraceptives and fertility.

Demand for General Health Care Services in Tanzania

General health services are important determinants of reproductive health. For example, the health of mothers and children in malaria prone regions is critically dependent on the availability and use of effective malaria treatments. Thus, credible policies for promoting reproductive health cannot be designed and implemented without a reliable framework for predicting the demand for general health care at health facilities. In designing reproductive health policies, policy makers may want to know why households use or do not use health facilities.

Sahn *et al.* (2003) analysed the determinants of household choice of health facilities in rural Tanzania using a nested multinomial logit model (see Equation 13). From the estimation results they computed the demand elasticities summarised in Table 3.2. The table indicates own price elasticities of demand for specific facilities (column 1) and for groups of facilities for which a range of substitute services, as well as for groups of facilities that have limited substitutes for the services they provide. The striking finding from the table is that own price elasticities at specific facilities are large (as expected) because of possibilities of service substitution, whereas demand for services at groups of facilities is price inelastic. A similar analysis can be conducted for reproductive health care, for which the results indicate the facilities at which service demand is most sensitive to price change, i.e., where demand for example would change substantially as a result of a small proportional change in prices. This information can be used to target reproductive health services to specific social groups, particularly by region. Notice that elasticities of demand for various contraceptive options such as the pill, the condom, IUD, etc. (see Table 3.1) can be estimated using a version of Equation 13 and applied similarly as the ones just discussed.

Table 3.2: Own price elasticities of demand in Tanzania

Facility type	Own price elasticities of demand	
	(1) At this facility	(2) All facilities
Public hospital	-1.859	-0.0530
Private hospital	-1.639	-0.0420
Public clinic	-0.343	-0.0390
Private clinic	-1.694	-0.0350

Source: Constructed from Sahn *et al.* (2003, Table 2, p. 11).

The Effect of Tetanus Immunisation on Birth Weight in Kenya

Rosenzweig and Schultz (1982, 1983) first applied the unified health care demand model presented in Section 2 in the United States. Here, we demonstrate the application of the model in a Kenyan context using nationally representative household data collected by the government in 1994 (see Mwabu, 2009). The survey data included immunisation of mothers during pregnancy, user charges for health care services, education of parents, and household income and assets. Other

data cover the infant's birth weight, whether the child was delivered at home or in health facility, and the time that the mothers spent on household chores such as collection of water and firewood.

The 1994 Kenyan data, permits joint estimation of models of reproductive health care demand and health production. Health is measured by birth weight. Birth weight is a good indicator of the health of the child in the womb because the weight is taken immediately after birth. Thus, a malnourished foetus will be born with low birth weight. The key determinants of birth weight include the nutritional status and age of the mother, the quantity and quality of antenatal care services received by the mother, immunisation of the mother against preventable diseases, and the mother's behaviour change during pregnancy such as quitting smoking. Other factors such as area of residence, which is a proxy for the availability of health care, and nutrients also affect the health of the child in utero.

Immunisation against tetanus during pregnancy is used as a proxy for antenatal care services received by a woman. Immunisation against tetanus is further assumed to be complementary to other inputs that improve the health of the child in the womb, such as presumptive malaria treatments and avoidance of risky behaviours. A thorough analysis of the complementarity hypothesis (the competing risk model) is in Dow *et al.* (1999). These authors observe that "...a woman will increase inputs into birth weight when she believes that the EPI will be available to increase the child's chances of surviving..." (p. 1362). Tetanus vaccination for pregnant women is one of the major components of the Expanded Programme on Immunisation (EPI), a worldwide vaccination initiative sponsored by the World Health Organisation (WHO), which also provides maternal services to women such as safe delivery and postnatal care.

In accordance with the complementarity argument, we assume that expectant women who received tetanus vaccination during the 1994 Kenyan survey were more likely to engage in demand behaviour that increased birth weight than women who were not immunised. The key argument is not that tetanus vaccination directly increases birth weight, but that vaccination is strongly correlated with health care consumption and behaviours that increase birth weight.

The general complementarity idea is that when a specific cause of a health problem is removed, other background causes follow suit, because people have incentives to remove them also. For example, a reduction in the risk of child death via immunisation against tetanus automatically reduces the risk of child death as a result of low birth weight. Stated differently, the adoption of a specific behaviour, or the uptake of a specific input that improves health, creates incentives to engage in other health-augmenting behaviours or consumption.

Such complementarities, which are analytically captured by Leontief preferences and technologies, are forms of positive social externalities of an intervention, i.e., large indirect and often unanticipated benefits of an innovation. For example, an intervention that improves obstetric care may have a larger benefit than that

associated with the reduction in the risk of infant deaths at birth. The obstetric care intervention could also give mothers an incentive to behave in ways that improve birth weight, thus reducing the risk of infants dying as a result of low birth weight.

However, mother's immunisation against tetanus immunisation could also induce moral hazard, a form of a negative social externality. For example, knowing that immunisation against tetanus protects them and their newborns from a tetanus infection during childbirth, the mothers might choose to deliver at home rather than at clinics. Such a choice could expose the newborn baby to death risks associated with poor general care during delivery, despite being at good health in utero.

We estimate demand for tetanus vaccination simultaneously with a model of birth weight determination. In the birth weight model, vaccination is assumed to improve child health in line with the complementarity hypothesis. Indeed, a positive empirical relationship between birth weight and tetanus vaccination is consistent with the complementarity hypothesis.

Measurement issues

Equation 2 is the appropriate framework for measuring the effect of tetanus vaccination on birth weight when Z is interpreted as tetanus vaccination and H as birth weight. (The classic paper on the connection between birth weight and general health is Waaler, 1984). In Equation 2, tetanus vaccination is endogenous to birth weight because it is a choice variable. Thus, instruments for tetanus vaccination are needed in order to consistently estimate the effect of vaccination on birth weight. The instruments for tetanus vaccination are factors that affect demand for tetanus vaccination without directly influencing the birth weight. These institutional and supply-side factors are household land holdings, household rent income, prices of health care and the amount of time women spend collecting water.

When estimating Equation 2, there is further need to deal with potential sample selection bias because some of the children in the 1994 survey did not have their birth weights recorded. This is particularly the case for children born at home rather than at clinics. The Heckman procedure (Heckit) is used to deal with the sample selection bias (Wooldridge, 2002). The first step in the application of the Heckit procedure is the identification of the probit equation. That is, the specification of factors that influence the selection of the unit of study into the estimation sample without directly affecting birth weight. In our case, the unit of analysis is a child. A child was included in the estimation sample only if he or she had a birth weight record extracted from a growth-monitoring card. The factors that identify the sample selection equation are the same as those that identify the demand for tetanus vaccination. Moreover, the heterogeneity of birth weight owing to non-linear interaction of tetanus vaccination with unobservables and omitted variables could bias the estimated structural coefficients. The control function approach (Garen, 1984; Wooldridge, 1997; Card, 2001) is used to address this issue.

Following Wooldridge (2002) and Mwabu (2009), we summarise the estimation strategy as follows:

$$B = w_1\delta_b + \delta M + \epsilon_1 \quad (23a)$$

$$M = w\delta_m + \epsilon_2 \quad (23b)$$

$$G = 1(w\delta_g + \epsilon_3 > 0) \quad (23c)$$

where B , M and G are birth weight, immunisation status of the mother, and an indicator function for selection of the observation into the sample, respectively and w_3 is a vector of exogenous covariates. The w are exogenous variables, consisting of w_0 covariates that belong in the birth weight equation and a vector of instrumental variables, w_1 , that affect immunisation status, M , but have no direct influence on birth weight, B ; and δ , β and ϵ are vectors of parameters, to be estimated and a disturbance term, respectively.

In the recent literature, the endogenous explanatory variables are commonly referred to as “treatment variables” (see Strauss and Thomas, 2008). This terminology stresses the fact that the most credible way to measure the effect of an endogenous variable on the outcome of interest (i.e., to identify *treatment effect*) is to vary the endogenous variable experimentally. In an experimental setting, this variation is achieved through a random assignment of units of study into *treatment* and *control* groups. The word “treatment” is used to indicate that a section of the study sample is “treated” (its characteristic of interest, such as immunisation, is varied exogenously). Since this variation occurs when other causal factors are held constant, it is possible to identify the effect of the characteristic on the outcome variable of interest, e.g., birth weight. In the absence of an experiment, such a variation is achieved through an econometric procedure, with the aid of a structural model (see Schultz and Strauss, 2008).

Equation 23a is the structural equation of interest, i.e., the birth weight production technology whose parameters are to be estimated. Equation 23b is the linear projection of the potentially endogenous variable, M , on all the exogenous variables, w , i.e., a reduced form linear probability model of vaccination.

The third equation (23c) is the probit for sample selection. It is the probability of a mother’s child being included in the estimation sample. It captures the fact that in the household survey, mothers who did not deliver at the clinics generally did not report birth weights for their children. Since the children without birth weights are excluded from Equation 23a, Equation 23c helps correct any sample selection bias in the estimated parameters. The correction factor, derived from Equation 23c, is the inverse of the Mills ratio.

To accommodate any non-linear interactions of unobservable variables with the birth weight regressors, and to account for sample selection bias, Equation 23a is rewritten as

$$B = \hat{\alpha}_0 + w_1\delta + \beta M + \hat{\alpha}_1 V + \gamma (V \times M) + \lambda Mills + u \quad (23d)$$

where:

- V = fitted residual of M (observed value of M minus its fitted value), derived from a linear probability model;
- $V \times M$ = interaction of the fitted immunisation residual with the actual value of the immunisation status;
- $Mills$ = inverse of the Mills ratio;
- u = a composite error term comprising ϵ_1 and a predicted part of ϵ_1 , under the assumption that $\Sigma(\epsilon_1) = 0$;
- $\delta, \beta, \alpha, \gamma$ and λ = parameters to be estimated.

The exclusion restrictions are imposed in Equation 23d because the vector of instruments, w_2 (for immunisation status, M), is absent from the equation. The terms V , $(V \times M)$ and $Mills$ in Equation 23d are the control function variables because they control for the effects of unobservable factors that would otherwise contaminate the estimates of structural parameters.

The reduced form immunisation residual, V , serves as the control for unobservable variables that are correlated with M . In particular, if an unobserved variable is linear in V , it is only the intercept, $\hat{\alpha}_0$, that is affected by the unobservable, and thus the IV estimates of Equation 23d are consistent even without the inclusion of the interaction term. The interaction term, $(V \times M)$, controls for the effects of any neglected non-linear interaction of an unobservable variable with the immunisation status of the mother. Specifically, if the effect of M on birth weight is influenced by an unobserved variable, say, α (which is correlated with M), this unobserved influence ($\alpha \times M$) is relegated to the structural error term and its source neglected during estimation. The estimated coefficient on M contains this neglected effect of unobserved variables; other structural coefficients may be similarly affected. Inclusion of the interaction term, $(V \times M)$, in Equation 23d purges the estimated coefficients of the effects of unobservables (see Card, 2001).

Empirically, an unobserved variable, say α , is represented by the reduced form immunisation residual. The interaction (multiplication) of V with M captures the idea that the size of α varies non-linearly with M . Thus, its unobserved and neglected effect ($\alpha \times M$) changes in a non-linear way as M changes. The inverse of the Mills ratio holds constant the effects of the non-random sample on structural parameters. Although the polynomials of the fitted residual term, V , and its interactions with exogenous covariates, i.e., w , can also be included in Equation 23d, the practice in the literature is to omit them or include them selectively (see Garen, 1984). It is possible to test which of the various versions of Equation 23d are consistent with data (see Mwabu, 2009).

The IV estimates of Equation 23d are unbiased and consistent only when one or the other of the following conditions holds (a) the expected value of the interaction between immunisation and its fitted residual ($V \times M$) is zero; or (b) the expectation of the interaction between immunisation and its fitted residual is linear (see Wooldridge, 1997).

Equation 23d can be estimated using the maximum likelihood estimation (MLE) procedure in STATA or similar software. Thus, inclusion of the inverse of the Mills ratio in Equation 23d as a regressor is redundant, because both its sample value and its coefficient are automatically generated upon convergence of the likelihood function.

Estimation results and discussion: full sample

Table 3.3 demonstrates how tetanus immunisation affects birth weight, controlling for other covariates of interest, notably the age and area of residence of the mother. As noted previously, immunisation is a proxy for health care inputs that improve birth weight such as the nutrition intake of the mother (Fogel, 2004). Table 3.3 summarises estimation results obtained from Equation 23d under different assumptions.

The table reveals the link between the demand for reproductive health care and health status at the earliest stage of the life cycle. The results of demand for tetanus immunisation from the full sample (the first-stage regression) are not reported in Table 3.3. Tables 3.4 and 3.5 present estimation results by residential area and household income. Household exogenous income is per capita *rent* income per month. The household income is *low* if it is at or below Ksh 700 (which was the food poverty line in 1994 (Republic of Kenya, 1996), and is *high* if it is more than Ksh 1,500. The results indicate that age and education of the mother, household land assets and income, and money and time costs of general health care, strongly affect the utilisation of vaccination services. The results are consistent with previous research in this area (see Ainsworth *et al.*, 1996; Gertler and van der Gaag, 1990; Acton, 1975). It should be noted that the instruments for the selection equation (Table 3.4, middle panel) are the same as the instruments for the immunisation equation (see Table 3.5).

Table 3.3: Estimation of vaccination demand and birth weight functions under different assumptions (*t*-statistics in parentheses)

Variables	Estimation methods				
	OLS	Heckit (ML procedure)	Control function approach (Dependent variable = birth weight)		
Sample selection variable (=1 if birth weight is not missing)	Birth weight equation	Sample selection variable (1= if birth weight is >0)	Birth weight equation	Linear interaction of vaccination with unobservables	Non-linear interaction of vaccination with unobservables
Mother's vaccination status (1=vaccinated)	1349 (3.96)		.1273 (3.71)	.2894 (2.19)	.5886 (2.55)
Age of mother, years	.0197 (4.12)	-.0121 (1.24)	.0199 (4.21)	0.0182 (3.69)	.0182 (2.97)
Age of mother squared ($\times 10^{-3}$)	-.2746 (4.27)	.1374 (1.02)	-.2734 (4.30)	-.2426 (3.49)	-.2450 (2.72)
Sex of the child (1 = Male)	.0986 (5.67)	.0001 (0.00)	.0981 (5.64)	.0984 (5.66)	.0979 (5.64)
Area of residence (1 = Rural)	-.3803 (1.73)	-.3307 (5.96)	-.0306 (1.35)	-.0328 (1.46)	-.0328 (1.31)
<i>Identification variables</i> (affect sample selection but not birth weight)					
Log of household land holding		-.1379 (6.97)			
Log of household rent income		.0220 (4.92)			
Mother's education		.0855 (18.5)			
Father's education		.0197 (4.78)			
Minutes spent to fetch water in wet season per day, cluster median ($\times 10^{-3}$)		-2.245 (3.17)			
Minutes spent to fetch water in dry season per day, cluster median ($\times 10^{-3}$)		-2.616 (8.02)			
User charges (Ksh) at private health facilities, cluster median ($\times 10^{-3}$)		-.7475 (3.77)			
<i>Control function variables</i> (account for birth weight effects of unobservables in the error term)					
Reduced form vaccination residual				-.1655 (1.22)	-.5508 (2.16)
Vaccination status x vaccination residual					.6041 (2.45)
Inverse of the Mills ratio [s.e.]		-.0351[.0302]			-.0159[.0457]
Constant	2.705 (29.10)	.3059 (1.70)	2.719 (29.2)	2.575 (18.1)	2.700 (9.80)
R-squared	0.016				
Wald statistic [p-value]		69.35 [0.000]			
Constant	2.705 29.10	.3059 (1.70)	2.719 (29.2)	2.575 (18.1)	2.700 (9.80)
R-squared	0.016				
Wald statistic [p-value]		69.35 [0.000]			
<i>H</i> ₀ : Correlation between reduced form immunisation error term and the structural error term = 0 [p-value]					0.24[0.623]
Sample sizes	4,162	7,838	4,162	4,162	
Total observations			7,838		
Censored obs			3,676		

The results in Table 3.3 indicate that birth weight is strongly associated with tetanus immunisation. The pattern of coefficients on mother's age in all specifications has an inverted U-shape, indicating that younger mothers are more likely than older women to deliver heavier babies. In all specifications, males are heavier at birth than females.

It is evident from Table 3.3 that the size of the effect of tetanus vaccination on birth weight depends on estimation method. Thus, it is important to use a proper estimation method to avoid misleading policy conclusions. The properly estimated effect of vaccination (the last column) is nearly five times greater than the OLS estimate (first column). The problems due to endogeneity and neglected non-linearities are revealed by a comparison of the Heckit estimates with the estimates derived via the control function approach. The Heckit estimate of the effect of immunisation on birth weight is .1273 (which is close to the OLS estimate of .1349), indicating that the coefficient changes very little with the removal of the sample selection bias. When the immunisation status of the mother is endogenised, however, the coefficient more than doubles to 0.289. Moreover, accounting for non-linear interactions of immunisation with unobservables further increases the coefficient to 0.588. This estimate reveals that immunisation (a proxy for the quality of health care received by the mother during pregnancy) substantially increases birth weight. In particular, tetanus immunisation in Kenya increased birth weight by nearly half a kilogram in 1994 (see also Mwabu, 2009).

The column labelled sample selection variable presents information on determinants of demand for births at health facilities because in this data set the reporting of a birth weight by mothers is strongly associated with a clinic birth. The probit results associated with the structural parameter estimates indicated in the last column of the table are not reported. An interesting finding from the probit estimates is that rural mothers are less likely than urban mothers to deliver at clinics, and that land holding reduces the probability of a clinic birth. These two findings are related because rural settings are associated with large land holdings. Household income and education increase the probability of reporting a birth weight. However, the money prices of general health services and the time spent on collecting water reduce this probability.

The coefficient on the reduced-form immunisation residual (last column) is statistically significant (t -ratio = 2.16). However, the coefficient on the inverse of the Mills ratio is insignificant, suggesting that sample selection bias is not a problem in this data set. That is, birth weight is not associated with the demand for clinic birth. The special case of the control function approach (the linear interaction of vaccination with its fitted residual) is interesting because the estimated coefficients of the birth weight technology under this specification are identical to the usual IV estimates. The estimates (except for the standard errors) correspond to those obtained under the strict assumption that the covariance between vaccination (the endogenous variable) and its fitted residual is zero (see Wooldridge, 1997).

The coefficient on the fitted residual without controls for non-linear interactions is .1655 (t -ratio = 1.22). With the controls for non-linear interactions between vaccination and unobservables, this coefficient increases to .5508 (t -ratio = 2.16), indicating that vaccination status is endogenous to birth weight. The control function approach is the appropriate estimation strategy because it takes into account both the endogeneity of vaccination, and the heterogeneity of response of birth weight to vaccination. The heterogeneity arises from non-linear interaction of vaccination with unobserved determinants of birth weight, such as the biological endowment of the mother and her environment. Inclusion of the control function variable, $(V \times M)$, in the birth weight equation purges the estimates of any effects of heterogeneity. The descriptive statistics associated with Table 3.3 are in Appendix tables 3.A1 and 3.A2.

Table 3.4: A linear probability model of demand for tetanus vaccination (t -statistics in parentheses)

Variables	Rural and urban subsamples		Income subsamples	
	Rural	Urban	Rural low income	Rural high income
Age of mother, years	.0081 (2.63)	.0125 (1.49)	.0080 (2.29)	.0207 (1.95)
Age of mother squared ($\times 10^{-3}$)	-.1624 (3.81)	-.2208 (1.64)	-.1617 (3.39)	-.3762 (2.28)
Sex of the child (1 = Male)	-.0034 (0.35)	-.0004 (0.02)	-.007 (0.56)	.0188 (0.91)
Area of residence (1 = Rural)	—	—	—	—
<i>Identification variables (affect demand for immunisations but not birth weight)</i>				
Log of household land holding	.0243 (3.64)	.0211 (1.45)	.0279 (3.43)	-.0049 (0.34)
Log of household rent income	.0044 (3.16)	-.0005 (0.27)	.0093 (3.59)	-.0117 (0.75)
Mother's education	.0116 (7.52)	.0039 (1.59)	.0131 (7.21)	.0053 (1.44)
Father's education	.0014 (1.06)	.0046 (2.45)	.0025 (1.59)	-.0022 (0.71)
Minutes spent to fetch water in wet season per day, cluster median ($\times 10^{-3}$)	-.9046 (3.28)	-2.293 (2.97)	-.9091 (2.92)	.1835 (0.22)
Minutes spent to fetch water in dry season per day, cluster median ($\times 10^{-3}$)	-.812 (6.16)	.591(1.40)	-.9577 (5.89)	-.5218 (2.12)
User charges (Ksh) at private health facilities, cluster median ($\times 10^{-3}$)	.1546 (1.13)	-.2671(5.23)	.4085 (2.41)	-.0464 (0.18)
Constant	.7364 (13.43)	.7348 (5.85)	.7150 (11.18)	.7438 (3.67)
R-squared	0.094	0.059	0.118	0.038
Sample sizes	3372	790	2448	602

Table 3.5: Estimation of birth weight production functions using the control function approach, by residential area and household income (*t*-statistics in parentheses)

Variables	All	Rural	Urban	Rural low-income	Rural high income
Mother's vaccination status (1=vaccinated)	.5886 (2.55)	.2982 (1.27)	2.069 (1.76)	.6422 (2.49)	-2.10 (2.57)
Age of mother, years	.0182 (2.97)	.02195 (3.40)	.0135 (0.64)	.0167 (2.36)	.066 (2.68)
Age of mother squared ($\times 10^{-3}$)	-.2450 (2.72)	-.3052 (3.28)	-.1875 (.55)	-.2352 (2.33)	-.9571 (2.50)
Sex of the child (1 = Male)	.0979 (5.64)	.0856 (4.41)	.1525 (3.92)	.0843 (3.73)	.0714 (1.53)
Area of residence (1 = Rural)	-.0328 (1.31)	—	—	—	—
<i>Control function variables (account for birth weight effects of unobservables)</i>					
Reduced form vaccination residual	.5508 (2.16)	.2178 (0.82)	2.38 (1.84)	.6049 (2.07)	2.46 (2.78)
Vaccination status $\times$ Vaccination residual	.6041 (2.45)	.5186 (2.01)	2.49 (1.90)	.6341 (2.24)	2.11 (2.33)
Inverse of the Mills ratio [se]	-.0159 [.0457]	-.0594 [.046]	-.0545 [.1060]	-.0077 [.0579]	-.1496 [.0885]
Constant	2.700 (9.80)	2.489 (10.1)	.8491 (0.69)	2.22 (8.15)	4.251 (5.10)
Wald statistic	58.35 (0.000)	54.69 (.000)	20.15 (.000)	45.34 (.000)	18.58 (.000)
Sample sizes	4,162	3,372	790	2,448	602

Discussion of results from various subsamples

The exclusion restrictions in Table 3.4 are valid because the hypothesis that the coefficients on these restrictions in the immunisation equation are jointly equal to zero can be rejected (test results are available from authors on request). The top panel in Table 3.4 indicates that age of the mother affects demand for tetanus vaccination. This effect is evident in all subsamples. In particular, demand for tetanus vaccination first increases with the age of the mother and then falls, indicating that younger mothers are more likely to use tetanus immunisation services compared with older women. This finding is mirrored in the upper panel of Table 3.5 where the effect of mother's age on birth weight first rises before it falls, indicating that the mean birth weight among younger mothers is higher than among older women.

In Table 3.4, land and income are shown to be important determinants of demand for tetanus vaccination in rural areas and among low-income mothers in rural areas. These variables have no effect on demand in urban areas and among high-income rural mothers, however. When we restrict our attention to the demand effects of land and income, we can discern that rich mothers in rural areas have immunisation

demand patterns similar to those of average mothers in urban areas. The correlations of demand, with education, are quite interesting. In rural areas, a mother's education is positively correlated with the utilisation of tetanus immunisation services. In urban areas, however, a woman's own education is weakly correlated with demand for tetanus immunisation. Instead, the main determinant of a woman's demand for vaccination is her spouse's education. Among high-income mothers in rural areas, education is not associated with a demand for immunisation. In contrast, women's education is strongly correlated with demand for tetanus immunisation among poor rural households.

The opportunity cost of time is negatively associated with the demand for tetanus vaccination in virtually all specifications. However, the signs of coefficients on the money prices charged for immunisation services differ between rural and urban subsamples. In the rural subsample, the coefficient is positive, which contradicts the law of demand; it is possible that in rural areas service prices are positively associated with service quality.

Table 3.5 reveals the control function parameter estimates of the birth weight production function. The table indicates estimates of the structural parameters of the birth weight equation using different subsamples. Except in the case of the high-income rural subsample, the effect of tetanus vaccination on birth weight is positive, a finding that is consistent with the complementarity hypothesis (Mwabu, 2009; Dow *et al.*, 1999). The last column of Table 3.5 suggests that mothers from high-income rural households have consumption or behaviour preferences that negatively affect birth weight. For example, although vaccinated mothers from high-income households have an incentive to invest in better nutrition, in accordance with the complementarity hypothesis, they also have greater opportunities to engage in consumption and behaviours that reduce birth weight, such as smoking and drinking alcohol. Grossman (1972) reported a similar finding in the context of general health. Apart from the negative coefficient on immunisation, the magnitude of this coefficient is implausibly large. Another notable finding from Table 3.5 is that male newborns are heavier than females in all subsamples, which is an indication that this estimate is quite robust.

The coefficients on reduced form immunisation residual and on the interaction term both indicate that the unobservables indeed have an effect on birth weight. See Table 3.5, column 1, which is a repetition of Table 3.3, last column. But these effects are not stable across subsamples (see the control function estimates in Table 3.5). As can be discerned from Table 3.5, the coefficient on immunisation is .2982 in the rural sample, but is nearly seven times as large (2.069) in the urban sample. Moreover, the variability of this coefficient is even greater between the high-income rural subsample (.6422) and the low-income subsample (-2.10) in the same area. There are many possible sources of this variation. One potential source is the type of information or counselling that mothers receive when accessing immunisation services. High-income rural mothers are more likely to both smoke and/or drink alcohol and to use immunisation services. That is, immunisation in a

high-income area is likely to be negatively correlated with birth weight, because of the negative effects of smoking and drinking alcohol on birth weight. As already noted, although mothers from such a sample are likely to be better nourished, the positive effect of nutrition on birth weight could easily be outweighed by the negative effects of factors associated with high income. The coefficient on the inverse of the Mills ratio is statistically insignificant in all subsamples, suggesting that sample selection bias is not a problem in this Kenyan data set.

Conclusion

A variety of demand frameworks have been reviewed in this chapter to demonstrate how they can be used to inform policies for improving the reproductive health of the population. The frameworks have the following key features. First, they can help identify constraints to the utilisation of commodities and services that are essential for improving reproductive health. Second, they provide an economic approach to the analysis of individual and household behaviours that promote reproductive health, thereby facilitating interdisciplinary research on such behaviours, e.g., the effects of smoking and breastfeeding on maternal and child health. Third, the specification form of these frameworks is likely to motivate policy makers to take demand estimates to the next stage, that examines the effects of service utilisation on health. Fourth, intra-household variations in reproductive health and in demands for reproductive health services and commodities can be studied using the frameworks. Because of data limitations, however, it was not possible to provide an illustrative application of an intra-household model in this chapter. Nonetheless, the theoretical frameworks provide insights into how to formulate policies for addressing inequalities in reproductive health within the household.

Some of the frameworks can be estimated using existing data sets. The Kenyan example, presented in this chapter, demonstrates this feasibility. The control function estimates of the birth weight production function suggest that the information that mothers possess about health-improving technologies plays a critical role in motivating them to invest in behaviours and consumption that complement tetanus immunisation in increasing birth weight. A woman's immunisation against tetanus while pregnant reduces the risk of the infant dying from tetanus infection during delivery. As a consequence, the complementary hypothesis of the competing risk model (Dow *et al.*, 1999) predicts that mothers would be strongly motivated to reduce other risks to child survival, e.g., the risk of a child dying from syndromes associated with low birth weight.

The mechanisms through which pregnant mothers reduce this risk include investing in better nutrition, avoiding smoking and alcohol, and using antenatal care services. These are elements of a health production technology. Unless mothers possess information about this technology, they are unlikely to adopt behaviours and consumption patterns that are complementary to tetanus immunisation in improving child health. For example, mothers could receive vaccination against tetanus, and

continue to smoke or consume alcohol because they lack information about the harmful effects of these types of consumption on the foetus. Such information can be provided at immunisation clinics. The information would reduce or close any knowledge gaps existing among women who receive tetanus immunisation at clinics.

We hypothesise that the heterogeneity of information on health-improving practices and technologies among women is the source of the variation in birth weight across income levels observed in Table 3.5. There is therefore need to investigate the content of the health education extended to mothers in different regions and at different clinics during vaccination days. Standardisation of such information would enable women to have access to the same reproductive health care technology. As a consequence, immunisation of mothers against tetanus (or implementation of safe delivery interventions) would be accompanied by behaviour and consumption patterns that increase rather than reduce child health.

More generally, the results in Table 3.5 suggest the need for health facilities and health policy makers to do more than simply immunise mothers. They suggest the need for immunisation-*plus* interventions. Specifically, when receiving immunisations, mothers should be counselled about other things they can do to maintain their health and that of their unborn children. Data on the content of the counselling that occurs during immunisation days would help design immunisation-plus programmes. Such information would be particularly germane to the immunisation-plus campaigns if it captures existing counselling practices in both rural and urban areas.

If the message contents of counselling are exactly the same in rural and urban areas, then there would be a basis for nuanced counselling over space and across income levels, and across other characteristics of mothers such as occupation, education and age. The information on the content of existing immunisation programmes would also provide a basis for pointing out the imperatives for effective empowerment of women (not giving out doles to them but providing sound education and training especially to young women and promoting remunerative employment for mothers). Indeed, the immunisation-plus interventions provide the link between reproductive health, economic growth and poverty reduction. The unified demand framework presented in the paper helps the policy makers evaluate how participation in immunisation-plus interventions empowers women by improving their health, equipping them with useful skills and connecting them to productive livelihoods. The collective household model that informs demand analysis can be used to assess whether empowerment of women benefits the whole family.

Because of data limitations, it was possible to illustrate empirically only a few of the frameworks presented in the chapter. For example, to implement intra-household models, information is needed on exogenous income or resources that are controlled by various household members. Panel data are also required to

analyse why some household members engage in practices that promote reproductive health while other members do not. A case in point is why some mothers deliver at clinics while others consistently choose to deliver at home. In addition to quantitative data of the type analysed in this chapter, qualitative data might be necessary to answer these sorts of questions. Experimental data may also be needed to deal with the difficult issues of inference and policy, e.g., why is fertility high in some regions or households? What is the effect of a fertility decline on women's health? Additional data sets are also needed to analyse the relationship between reproductive health and poverty dynamics.

References

- Acton, Jan Paul. 1975. "Nonmonetary Factors in the demand for medical services: Some empirical evidence". *Journal of Political Economy*, 83 (3): 595–614.
- Ainsworth, Martha, Kathleen Beegle and Andrew Nyamete. 1996., "The impact of women's schooling on fertility and contraceptive use: A study of 14 Sub-Saharan countries". *World Bank Economic Review*, 10 (1): 85–122.
- Akin, J., C. Griffin, D.K. Guilkey and B.M. Popkin. 1986. "The demand for primary health care services in the Bicol region of the Philippines". *Economic Development and Cultural Change*, 34 (4): 755–82.
- Akin, J., D.K. Guilkey, P. Hutchinson and M. McIntosh. 1998. "Price elasticities of the demand for curative health care with control for sample selectivity and endogenous illness: An analysis for Sri Lanka". *Health Economics*, 7 (6): 509–31.
- Alderman, Harold, Pierre-Andre Chiappori, Lawrence Haddad, John Hoddinott and Ravi Kanbur. 1995. "Unitary versus collective models of the household: Is it time to shift the burden of proof?" *World Bank Research Observer*, 10 (1): 1–19.
- Becker, Gary S. 1974. "A theory of social interactions". *Journal of Political Economy*, 82 (6): 813–46.
- Becker, Gary S. 1981. *A Treatise on the Family*. Cambridge, Massachusetts: Harvard University Press.
- Bergstrom, T.C. 1989. "A fresh look at the Rotten Kid theorem – and other household mysteries". *Journal of Political Economy*, 97 (5): 1138–59.
- Bound, J., D. Jaeger and R. Baker. 1995. "Problems with instrumental variables estimation when the correlation between the instruments and the endogenous explanatory variables is weak". *Journal of the American Statistical Association*, 90 (430): 443–50.
- Browning, Martin, Francois Bourguignon, Pierre-Andre Chiappori and Valerie Lechene. 1994. "Incomes and outcomes: A structural model of intrahousehold allocations". *Journal of Political Economy*, 102 (6): 1067–96.
- Card, David. 2001. "Estimating the return to schooling: progress on some persistent econometric problems". *Econometrica*, 69 (5): 1127–60.

- Chen, Zhiqi and Frances Woolley. 2001. "A Cournot-Nash model of family decision making". *Economic Journal*, 111 (474): 722–48.
- Chiappori, Pierre-Andre. 1988. "Rational household labour supply". *Econometrica*, 56 (1): 63–90.
- Culyer, A.J. and J. Newhouse, eds. 2000. *Handbook of Health Economics*, Volumes 1A and 1B. Amsterdam: Elsevier, North-Holland.
- Diewert, W.E. 1971. "An application of the Shephard duality theorem: A generalised Leontief production function". *Journal of Political Economy*, 79 (3): 481–507.
- Dow, William H. 1999. "Flexible discrete choice demand models consistent with utility maximisation: An application to health care demand". *American Journal of Agricultural Economics*, 81 (3): 680–85.
- Dow, William H., Thomas J. Philipson and Xavier Sala-i-Martin. 1999. "Longevity complementarities under competing risks". *American Economic Review*, 89 (5): 1358–71.
- Fogel, Robert W. 2004. *The Escape from Hunger and Premature Death, 1700–2100: Europe, America and the Third World*. Cambridge: Cambridge University Press.
- Garen, John. 1984. "The returns to schooling: A selectivity bias approach with a continuous choice variable". *Econometrica*, 52 (5): 1199–218.
- Gertler, P. and Jacques van der Gaag. 1990. *Health Care Financing in Developing Countries*. Baltimore: Johns Hopkins University Press.
- Grossman, Michael (1972), "On the concept of health capital and the demand for health", *Journal of Political Economy*, 80 (2): 223–255.
- Haddad, L., J. Hoddinott and H. Alderman, eds. 1997. *Intrahousehold Resources and Allocation in Developing Countries*. Baltimore: Johns Hopkins University Press.
- Lundberg, Shelly and Robert A. Pollak. 1993. "Separate spheres bargaining models of marriage". *Journal of Political Economy*, 106 (6): 988–1010.
- Lundberg, Shelly and Robert A. Pollak. 1994. "Non cooperative bargaining models of marriage". *American Economic Review*, 84 (2): 132–7.
- Manser, Marilyn and Murray Brown. 1980. "Marriage and household-making: A bargaining analysis". *International Economic Review*, 21 (1): 31–44.
- McElroy, Marjorie B. and Mary J. Horney. 1981. "Nash-bargained decisions: Towards a generalisation of the theory of demand". *International Economic Review*, 22 (2): 333–49.
- McElroy, Marjorie B. 1990. "The empirical content of Nash-bargained household behavior". *Journal of Human Resources*, 25 (4): 559–83.
- Mwabu, G. 2008. "Health economics for low-income countries". In T.P. Schultz and J. Strauss, eds., *Handbook of Development Economics*, volume 4. Amsterdam: Elsevier Science, North-Holland.

- Mwabu, G. 2009. "The production of child health in Kenya: A structural model of birth weight". *Journal of African Economies*, 18 (2): 212–260.
- Rosenzweig, Mark R. and T. Paul Schultz. 1982. "The behavior of mothers as inputs to child health: The determinants of birth weight, gestation, and the rate of fetal growth". In Victor R. Fuchs, ed., *Economic Aspects of Health*, pp. 53–92. Chicago: The University of Chicago Press.
- Rosenzweig, Mark R. and T. Paul Schultz. 1983. "Estimating a household production function: Heterogeneity, the demand for health inputs, and their effects on birth weight". *Journal of Political Economy*, 91 (5): 723–46.
- Rosenzweig, Mark R. and T. Paul Schultz. 1987. "Fertility and investments in human capital: Estimates of the consequences of imperfect fertility control in Malaysia". *Journal of Econometrics*, 36: 163–84.
- Rosenzweig, Mark R. and Kenneth Wolpin. 2000. "'Natural' experiments in economics". *Journal of Economic Literature*, 38 (4): 827–74.
- Sahn, David E., Stephen D. Younger and Garance Genicot. 2003. "The demand for health care services in rural Tanzania". *Oxford Bulletin of Economics and Statistics*, 65 (2): 241–59.
- Schultz, T. Paul. 2004. "Health economics and applications in developing countries". *Journal of Health Economics*, 23 (4): 637–41.
- Schultz, T. Paul and John Strauss, eds. 2008. *Handbook of Development Economics*, Volume 4. Amsterdam: Elsevier Science, North-Holland.
- Singh, Inderjit, J. Lyn Squire and John Strauss, eds. 1986. *Agricultural Household Models: Extension, Application and Policy*. Baltimore, Maryland: Johns Hopkins University Press.
- Strauss, John. 1986. "Does better nutrition raise farm productivity?" *Journal of Political Economy*, 94 (2): 297–320.
- Strauss, John and Duncan Thomas. 1995. "Human resources: Empirical modeling of household and family decisions". In J. Behrman and T.N. Srinivasan, eds, *Handbook of Development Economics*, Vol. 3A, pp. 1883–2023. Amsterdam: Elsevier Science, North-Holland.
- Strauss, John and Duncan Thomas. 1998. "Health, nutrition, and economic development". *Journal of Economic Literature*, 36 (2): 766–817.
- Strauss, John and Thomas, Duncan. 2008. "Health over the life course". In T. Paul Schultz and John Strauss, eds., *Handbook of Development Economics*, Volume 4. Amsterdam: Elsevier Science, North-Holland.
- Thomas, Duncan. 1990. "Intrahousehold resource allocation: An inferential approach". *Journal of Human Resources*, 25 (4): 635–64.
- Thomas, Duncan. 2000. "Comments on 'Intrahousehold allocations'". *Journal of African Economies*, 9 (AERC Supplement 1): 144–49.

- Todd, Petra E. 2008. "Evaluating social programs with endogenous program placement and selection of the treated". In T.P. Schultz and J. Strauss, eds., *Handbook of Development Economics*, Volume 4. Amsterdam: Elsevier Science, North-Holland.
- Waller, Hans Th. 1984. "Height, weight and mortality: The Norwegian experience". *Acta Medica Scandinavica*, 679 (Supplement): 1–56.
- Wooldridge, Jeffrey M. 1997. "On two stage least squares estimation of the average treatment effect in a random coefficient model". *Economics Letters*, 56: 129–33.
- Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Massachusetts: MIT Press.

Appendix

Table 3.A1: Descriptive statistics, selected sample

Variable	Obs	Mean	Std. Dev.	Min	Max
Birth weight (kg)	4,162	3.175709	.5653995	1	5
Immunisation	4,162	.9137434	.2807763	0	1
Predicted imm	4,162	.9137434	.082934	-.1094432	1.114153
Pred residual	4,162	-1.32e-10	.2682486	-1.038387	.8044392
Mother age, years	4,162	29.2852	6.991334	16	91
Immun $\times$ resid	4,162	.07194	.0710595	-.1141534	.8044392
Mother age sq	4,162	906.4899	490.9636	256	8281
Sex (male=1)	4,162	.5057665	.5000268	0	1
Rural (=1)	4,162	.8101874	.3921999	0	1
Log land	4,162	.9089697	.7845221	0	4.61512
Log rent income	4,162	2.906136	3.586057	0	11.05091
Mother education	4,162	6.909178	3.82128	0	16
Father education	4,162	6.891567	4.480119	0	16
Water min, wet	4,162	17.51562	21.01926	0	360
Water min., dry	4,162	26.65017	42.44428	0	780
User fees, private	4,162	35.14031	78.5439	0	1265.83

Table 3.A2: Descriptive statistics, full sample

Variable	Obs	Mean	Std. Dev.	Min	Max
Birth weight, kg	4,174	3.175419	.5649474	1	5
Immunisation (=1)	7,861	.8252131	.3798089	0	1
Predicted immuniz	7,838	.8679894	.1435308	-.1275014	1.114153
Immuniz residual	7,838	-.0430341	.3395746	-1.044042	.9328943
Age mother, years	7,861	30.24539	7.645715	15	91
Immuniz $\times$ resid	7,838	.0840497	.0898886	-.1141534	.9328943
Age mother square	7,861	973.233	554.098	225	8281
Sex child (1=Male	7,861	.502735	.5000243	0	1
Rural (=1)	7,861	.8707544	.335493	0	1
Birth weight report	7,861	.5309757	.4990713	0	1
Log land	7,838	.9974064	.8516709	0	5.303305
Log rent income	7,861	2.581198	3.441401	0	11.05091
Mother ed., years	7,861	5.441547	4.221362	0	16
Father ed., years	7,861	5.685116	4.631377	0	16
Water minutes, wet	7,859	26.45731	43.74528	0	480
Water minutes, dry	7,859	49.19112	100.1076	0	780
User fees, private (Sh)	7,861	32.11538	82.32426	0	2389.583

Provision and Organisation of Reproductive Health Services in Sub-Saharan Africa

Joseph K. Wang'ombe and Mercy G. Mugo

Introduction

The scope of work for reproductive health is clearly determined by the definition adopted by the United Nations' International Conference on Population and Development (ICPD), held in Cairo in 1994. The ICPD definition marked a major paradigm shift in the way the world viewed this issue:¹

Reproductive health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity, in all matters relating to the reproductive system and to its functions and processes. Reproductive health therefore implies that people are able to have a satisfying and safe sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so. Implicit in this last condition are the rights of men and women to be informed and to have access to safe, effective, affordable and acceptable methods of family planning of their choice, as well as other methods of their choice for the regulation of fertility which are not against the law, and the right of access to appropriate health care services that will enable women to go safely through pregnancy and childbirth and provide couples with the best chance of having a healthy infant. In line with the above definition of reproductive health, reproductive health care is defined as the constellation of methods, techniques and services that contribute to reproductive health and well-being by preventing and solving reproductive health problems. It also includes sexual health, the purpose of which is the enhancement of life and personal relations, and not merely counselling and care related to reproduction and sexually transmitted diseases.

Background Issues

The achievement of the ideal state of reproductive health is far from being realised in the developing world and especially the sub-Saharan Africa (SSA) region

¹ ICPD Programme of Action, Paragraph 7.2.

because of the problems that engulf the delivery systems. Millions of individuals and couples around the world are unable to plan their families as they wish. It is estimated that over 120 million couples do not use contraceptives, despite wanting to space or limit their childbearing. In addition, many women who use contraceptives nevertheless become pregnant. Other couples who want to have children are unable to conceive. The highest unmet need for family planning is in SSA where on average 19.4 per cent of all women have unmet need. Some of the causes of unmet needs for family planning services are lack of services or barriers to their access, poor quality of services, and technology issues such as limited or inappropriate choice of method. Others encompass broader social issues such as an individuals lack of knowledge; power imbalances within couples and families; and socio-cultural, religious and gender barriers (WHO, 2006; Levine *et al.*, 2006).

More than 99 per cent of pregnancy related deaths occur in the developing world. In addition, many of the causes of maternal death and disability also jeopardise the survival and health of newborn infants. Nearly 4 million newborn babies die each year because of poorly managed pregnancy or delivery or because of the mothers' poor health. In 2004, neonatal deaths represented 36 per cent of all deaths of children under five in developing countries (WHO, 2006; Graham *et al.*, 2006).

Sexually transmitted infections (STIs) and reproductive tract infections (RTIs) are responsible for considerable ill health throughout the world, both directly and by increasing the risk of transmission of human immunodeficiency virus (HIV). Each year there are an estimated 340 million new cases of curable STIs as well as many cases of incurable viral STIs, including some 5 million new HIV infections. STIs are responsible for an enormous burden of morbidity and mortality in many developing countries because of their effect on reproductive and child health. In developing countries, high levels of STIs and high rates of complications and sequelae result largely from inadequacies in health service provision and health care seeking (WHO, 2006; Aral and Over, 2006).

Accurate numbers of abortions are difficult to obtain in most parts of the world, but it is estimated that about one-fourth of 210 million pregnancies each year end in abortion. Unsafe abortion results in the deaths of 68,000 women every year and leaves an additional 5 million temporarily or permanently disabled. An estimated 19 million unsafe abortions take place each year, almost all of which are in developing countries (WHO, 2006; Levine *et al.*, 2006).

Issues of gender inequality and reproductive rights are inextricably intertwined with sexual and reproductive health. Discrimination against girls and women often places them at a disadvantage in terms of decision making power, choices and opportunities. If they are to achieve sexual and reproductive health, people must be empowered to exercise control over their sexual and reproductive lives and must have access to related health services. There is currently insufficient evidence on the magnitude of the discrimination problem in respect to sexual and reproductive health (WHO, 2006).

The sexual and reproductive health needs of adolescents differ from those of adults, and remain poorly understood and inadequately served in many parts of the world. In many countries, young people are increasingly exposed to the health risks associated with unsafe sex. In the assessment of burden of disease, sexual and reproductive health conditions account for 33 per cent of young women's disability adjusted life years (DALYs), much higher than the 10 per cent for young men (WHO, 2006; Lule *et al.*, 2006).

The ideal traditional approach in dealing with reproductive health has been to provide quality, accessible, affordable and acceptable reproductive health services. A look at the problem of reproductive health reveals a considerable extent of under-achievement. Both supply and demand sides of the reproductive health services scenarios would provide explanations for the under performance of the systems. On the supply side, issues related to achievements of institutional frameworks, administration and management, facilities and technologies, costs and financing, form the baseline for explanations of provision inadequacies. On the demand side, explanators for the ineffective demand for reproductive health can be teased out of the complex of socioeconomic characteristics of the populations. The socioeconomic characteristics commonly found in the literature include education, income, gender, and cultural and religious values, among others. The main focus of this chapter is on the supply-side of the reproductive health scenario.

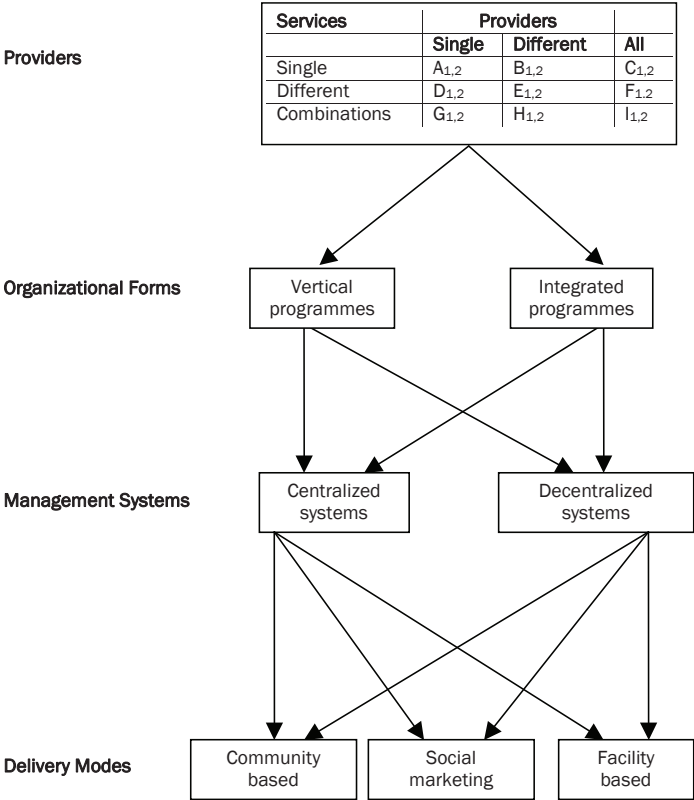
The chapter is based on an extensive review of the empirical literature on the provision of reproductive health services. An Internet search was conducted using combined search terms that included: reproductive health services; use; provision issues organisation; Africa; theoretical and analytical models; funding; methodological issues; empirical studies; developing countries; costs; economic analysis; population dynamics; and contraceptives. The search also included manual retrieval of materials from national and international agency libraries. The search yielded 67 relevant titles.

The chapter is divided into four sections. Section 2 configures a scheme of reproductive health service provision models and proposes simplified scheme of the functional connection between service providers, organisational forms, management systems and delivery modes. A review of the use of theoretical and empirical models in the provision of reproductive health services is conducted in Section 3. The review demonstrates how the models are used to guide the formulation of the programmes and interventions forming the evaluation basis that relate interventions to results and effects. Section 4 presents the topical issues of concern. Features of provision models that facilitate or hinder access and uptake of reproductive health services are discussed, together with the challenges facing the provision of sexual and reproductive health services. The last section presents a summary of emerging issues and a research agenda for the provision of sexual and reproductive health services.

Reproductive Health Service Provision Models

Systems of reproductive health service delivery described in the literature are many and complex. This section attempts to simplify things by grouping the main features into four interrelated scheme components. These are service providers, service delivery organisational forms, management systems and delivery modes. The population to which services are delivered, besides being seen as a whole, is also known to comprise different special reproductive health needs categories such as women, men, infants, adolescents and youth. The population distribution by way of rural-urban and rich-poor also has a bearing on how the provision systems are organised and operated. Figure 4.1 represents a schema of possible reproductive health service provision models. It indicates the variety of combinations of provider choices, organisational forms, management systems and delivery modes for selected or combinations of reproductive health service components.

Figure 4.1: Reproductive health service provision models



Service Providers

Social provision models are multidimensional involving efforts of state, market and civil society to provide different types of services to a whole population or its

segments. Four provision scenarios are discernible: identical services being provided to the population by different providers; different components of the same service being delivered to the same population by different providers; different providers cooperating in the delivery of the same services to a given population; and a situation where a minimum level of service is provided to all by government free of charge with minimum addition being provided at a price by public or private sector (Mwabu *et al.*, 2001). Figure 4.1 generates similar scenarios of institutional arrangements for reproductive health service provision. The provider range includes the government (public), private-for-profit and private-not-for-profit (non-government and faith-based organisations, NGOs and FBOs, respectively), which provide services singly or in combinations. The range of services is as presented in the ICPD definition of reproductive health, and is provided to the whole population or to population segments as special needs groups. Population segmentation may be manifest in the population structure or geographical location.

The scheme generates nine theoretical service and provider combination scenarios. Scenario A_{1,2} represents a situation in which a single service is provided by a single provider to the whole population or segments thereof, while in Scenario B_{1,2} a single service is provided by different providers to the whole population or its segments. In Scenario C_{1,2}, a single service is provided by all providers to the whole population or its segments and in Scenario D_{1,2} different combinations of services are provided by a single provider to the whole population or its segments.

Scenario E_{1,2} illustrates different combinations of services provided by different providers to the whole population or its segments. Scenario F_{1,2} is a situation in which different combinations of services are provided by all providers to the whole population or its segments. In Scenario G_{1,2}, all services are provided by a single provider to the whole population or its segments.

In Scenario H_{1,2} all services are provided by different providers to the whole population or its segments, i.e., the expected range of services is available if the different providers are considered together.² Scenario I_{1,2}, by comparison, has all providers individually able to provide all services to the whole population or its segments, i.e., government and non-government institutions are all individually able to provide the full range of all RH services that are expected in the system.

Our search of 67 selected papers on delivery of reproductive health services in African and other developing countries yielded six of the nine theoretical service and provider combination scenarios. C_{1,2}, H_{1,2} and I_{1,2} were not represented at all, and Scenarios F_{1,2} and G_{1,2} were represented only once (Hardee *et al.*, 1999, and Berer, 2003, respectively). Hardee *et al.* (1999) reviews among others the situation in Ghana where the Ministry of Health, NGOs and the private sector are involved in the provision of different components of reproductive health services. Berer (2003) reviews efforts of ministries of health to deliver the full package of reproductive health services (MCH, FP, STIs, HIV/AIDS, infertility, abortion and cancers of the reproductive tract) in an integrated approach.

The four commonest service provision scenarios are $E_{1,2}$ with 22 representations; $B_{1,2}$ with 10; $A_{1,2}$ with 7 and $D_{1,2}$ with 5. Scenario $E_{1,2}$ illustrates the concerted effort in many countries by different providers engaged in the provision of the components of RH services for which they may have a comparative advantage or identified as the mission of the organisation especially the non-government sector. Lawn *et al.* (2006) provide a comparative overview of efforts of ministries of health with support of donors in maternal and neonatal interventions in 45 countries. Mensch *et al.* (1994) describe integration efforts in Nigeria, Tanzania and Zimbabwe in maternal child health (MCH) and family planning by governments (MOH), international non-government organisations like the International Planned Parenthood Federation (IPPF), and donor agencies such as the United States Agency for International Development (USAID). Other similar combinations involving governments (MOHs), NGOs, private sector communities and international agencies are described in evaluation reports, research work and policy documentation by Lule *et al.* (2006), Stewart *et al.* (1999), Hogan *et al.* (1999), Ensor and Ronoh (2005), RamaRao and Mohanam (2003), Mayhew and Adjei (2004), and Tuoane *et al.* (2004), among others.

Scenario $B_{1,2}$ reveals targeted efforts by different agencies on a single service for example family planning or MCH. The single service may be delivered to all the country population or to special interest groups. Levine *et al.* (2006) discuss literature on issues pertaining to efforts by the public and private sectors in providing family planning through vertical, integrated and social marketing interventions to the whole population and selected worker groups. Family planning services seem to feature as the common services for scenario $A_{1,2}$. Agha (2002) and Bertrand *et al.* (1984) evaluate the performance of special interventions in the provision of contraceptives as an input in adolescent sexual and reproductive health in Cameroon, Botswana, South Africa and Guinea and as community-based distribution of contraceptives in the Bas region of Zaire, respectively. Similar cases of a single provider concentrating on one service are described in Phillips and Hossain (2003), Ronsmans *et al.* (2003), ReformPlus (2004), Phillips *et al.* (1998), and Charkraborty *et al.* (2003). Huntington and Nawar (2003) and Schuler *et al.* (2002) provide examples of $D_{1,2}$, in which single providers concentrate on provision of different combinations of RH services. Huntington and Nawar (2003) discuss NGOs concerns in integrating post-abortion care with MCH, while Schuler *et al.*, (2002) provide evidence on efforts of a consortium of NGOs in Bangladesh to integrate family planning services into an essential services package (also see Kamau, 2006; Berer, 2004).

The service and provider combination scenarios represented in the literature may exist individually or in multiplicity within a country or its regions.

Organisational Forms, Management Systems and Delivery Modes

Provider service combination scenarios may be actualised through the choice of the potentially most appropriate and efficient organisational form, management system

and delivery mode. From Figure 4.1 it is possible to decipher 12 possible theoretical combinations of provision models. Organisational forms and management systems can be combined to yield vertical centralised or decentralised and integrated centralised or decentralised systems. Services thus organised and managed can be delivered through community-based, social marketing or facility-based modes. In the rest of this section, we describe the characteristics of each of the organisational forms, management systems and delivery modes and delineate the range of areas of formulating issues of inquiry in respect to technical and allocative efficiency.

Organisational forms

Organisational forms fall into two categories: vertical programmes and integrated programmes. Each has its pros and cons.

Vertical programmes. A programme is classified in the category of vertical programmes if it exhibits a dominance of several operational and structural characteristics. It (a) concentrates on a single service or specific combination of components of a service at the exclusion of others, (b) encompasses a set of institutions and sometimes manpower devoted entirely to the provision of the selected services, (c) supports an infrastructure also devoted to the provision of the service, and (d) may target its service(s) to certain population groups and/or geographical areas. An example may be a national family planning programme that establishes branches in the country and a supply system for commodities and information. RamaRao and Mohanam (2003), in a review of the aspect of quality of family planning intervention programmes and its implications for the use of FP services describe such systems in Turkey, Russia, Tanzania and Senegal. In Tanzania they reveal that a project was started in 1988 to enhance access to permanent and long-acting family planning methods. Different cadres of staff were specially trained in provision and quality assurance of 72 centres that were established throughout the country. A logistical support system was also established for the project (also see Stewart *et al.*, 1999; Mayhew *et al.*, 2004).

Integrated programmes. In this context, integration refers to the situation in which the control of management, budgeting, funding and provision of reproductive health services is situated within the MOH and its constituent decentralised levels rather than in a separate directorate. At the service level, integration is the process through which reproductive health services are provided in cooperation with other health services. A reproductive health service delivery organisation form will be described as integrated when it exhibits the following characteristics: (a) provides two or more services together that could be provided separately, (b) it has multipurpose staff, (c) budget and finance reflect the connectedness of the provision process, and (d) institutions and infrastructure are multipurpose. Reference to integration begins to appear in the planning and management literature when MCH and family planning components of reproductive health care are provided in conjunction with other curative services at different levels of health care delivery (Berer, 2003). Bertrand *et al.* (1984) reveal how distribution of contraceptives in integration with

the delivery of drugs to combat malaria, intestinal parasites and dehydration from diarrhoea among under-fives encouraged the uptake of family planning among mothers in rural and urban Zaire. Further arguments in favour of integrated organisational forms for different components of reproductive health services and reports on programmes are provided in Lawn *et al.* (2006), Levine *et al.* (2006), Huntington and Nawar (2003), Tuoane *et al.* (2004), and Maguire *et al.* (1982).

Management systems

As a necessity for implementation, an organisational form requires a management system. Such a system may be as result of historical socioeconomic factors or deliberate implementation of changes for the purpose of enhancing the system's achievements. Health services management systems in the African situation can either be centralised or decentralised.

Centralised systems. Historically, centralised systems are more common in Africa. The Ministry of Health (MOH) is traditionally the health services provider by law, with other providers playing their part under the permission and supervision of the MOH. The dominant characteristics of the centralised system include the presence of a central command system with one chief officer normally at the headquarters. The pecking order creates lower divisions out to the periphery; these may be provinces, districts, counties, etc. There is also uniformity of staff and administration structures at every level, while budgets are made at the central bureau and distributed to the peripheral units to be expended on rules set by the centre. Besides the MOH, the characteristics are observable in programmes set up by NGO and other agencies that are centrally managed and have a national, provincial or district base.

In many countries, MCH and family planning services are managed centrally because of the deemed efficiency in delivering *without delay the special* benefits to the target population groups and the ease with which funds for them can be sought from outside (Ensor and Ronoh, 2005). The tendency for strong central authority is further justified on the grounds of the relative inexperience of staff in the peripheral areas to manage programmes and the need to guard against abuse of resources (not uncommon in many institutions in African settings). However, inefficiencies may arise from poor communications systems that hamper central programme support, management and supervision (Bertrand and Brown, 1992) as well as procurement and distribution of RH supplies and the bureaucracy inherent in centralised systems.

Decentralised systems. A main feature of health sector reform, during the past two decades, has been decentralisation. It has been popular because it is deemed to enhance technical and allocative efficiency in the delivery of health services; it is also said to reduce costs, increase relevance and improve access. In respect to RH, concerns have been related to integration at the policy and programmatic levels (Ensor and Ronoh, 2005; Krasovec and Shaw, 2000). From past experience in the health sector reform process, decentralisation would fall into three configurations:

Deconcentration: Occurs when local agencies are allocated resources to provide and partly plan services. The local agencies remain accountable to the centre for their achievement; they are also supervised from there. For example, a district may be allocated funds to provide MCH services, but the ministry supervises the process and performance; *Delegation*: Occurs when responsibility for running services is allocated to a semi-autonomous agency, outside the regular bureaucratic structure, usually MOH. For example, the ministry may give the responsibility of quality assurance in a certain district to a parastatal or an NGO that has more presence on the ground than the ministry; *Devolution*: Occurs when authority to organise, provide and partly finance services is given to the local government or a similar agency with capacity, the agency is responsible to the local population. A case in point is that of Uganda where districts have the authority to determine the service mix, hire staff and collect their own funds for health services (Ensor and Ronoh, 2005).

Service delivery modes

The bottom layer of the service delivery model comprises the direct active link with the population. It entails a set-up of service infrastructure and processes for individuals, households or population groups. There is abundant literature is replete with examples of the three main types of RH services delivery modes. These are either in combination or stand-alone: community-based distribution (CBD), social marketing, and facility- or clinic-based modes of service delivery (Figure 4.1).

Community-based mode. Many examples of community involvement in reproductive health services delivery refer to activities in family planning. Community involvement is favoured for many rural settings and urban settlements that reproduce rural life styles because the approach is able to accommodate social cultural imperatives of values, needs, power relations and social capital. Because populations in Africa and in the rest of the developing world remain predominantly rural, community involvement has dominated most of the recent innovations in delivery of RH services (Askew and Khan, 1990). Nonetheless, the variations in the relevant social and cultural imperatives from one population to the other mean that the differences in the details of the operational formats may be as many as there are examples.

In the Zairian CBD model, for example, nurses in government and church operated clinics were trained in FP delivery and were supplied/resupplied with free contraceptives to sell to clients. There was also an extensive outreach programme consisting mainly of home visiting and the free household distribution of contraceptives, although after acceptance, the client had to pay a nominal fee for re-supply. Further development of the model, dispensed with salaried home visitors replacing them with “home depots” where volunteer community residents stocked contraceptives in their homes and sold them to friends and neighbours at a small commission. The CBD workers were encouraged to make their services widely known in the neighbourhood (Bertrand and Brown, 1992). The main activities of a

CBD model may include: recruiting and training CBD workers; training nurses in clinics; supervising and resupplying the CBD workers and clinic nurses monthly; and collecting statistics on monitoring the volume of contraceptives sold by the distributor or clinic each month.

Social marketing mode. The social marketing mode of delivery exploits social outlets for services, commodities and information. It is commonly used for improving access and availability of family planning commodities and information. Many designs of social marketing involve commercial sales of branded contraceptives such as condoms and spermicides in outlets such as pharmacies and shops. In many African countries the activities are organised and operated by international agencies such as Population Services International (PSI) with funding from donors such as USAID, IPPF and UNFPA among others. The donors provide contraceptives and programme support, training and public education as well as coordination of regional committees. Social marketing, initiated by PSI, has been one of the most successful contraceptive efforts in Zaire (Bertrand and Brown, 1992).

Facility-based mode. The foundation of the delivery of RH services in Africa lies at the clinic or other health facility. The recognition of RH services as a special need in Africa is derived from a health rationale rather than from economic and demographic rationales. The health rationale emphasises spacing pregnancies and maintaining good reproductive health; hence the control and treatment of STI are also important functions of the health facility. The economic/demographic rationale focuses on limiting births. The clinic offers a wide range of contraceptives and provides other MCH services. Infections of the reproductive system are treated at the clinic (Miller *et al.*, 1998). Clinic personnel are trained to provide more than just RH services and in many situations have the backup of laboratory services. Ideally, the clinics are available and accessible to all sectors of the population.

Major Actors and Their Roles in the Delivery of Reproductive Health Care

“Everyone is entitled to the minimum health care package”. This is a common expression in everyday parlance when commenting on the performance of health systems in the provision of health care especially in the developing world. It refers to the meritorious aims of public health services. Health care is essential for maintaining a healthy population to enhance the quality and volume of human capital in an economy. Externalities from providing specialised public health services like reproductive health care are important and have positive effects on general social welfare; for example effective maternal care programme is expected to support child welfare, which may translate to fortified child growth in the short run and to good school performance in the long run (if all other necessary conditions obtain).

The externalities generated in the process of providing and consuming public health services become the basic argument for state subsidy. Market failures simply imply

that except for the provision of the private components of reproductive health inputs like treatment of STI or post-abortion care, the market will not freely encourage investment in the production of such services. The standard market does not give incentives to private producers to invest in services some of whose effects they will not be able to package for the market. This has resulted in the development of publicly guided systems of providing RH services (Appleton, 2001; Mwabu, 2001). The actors in the system can be grouped into three categories: the household, which mainly comprises consumers of the service, the private sector and the government. The latter two may be involved as direct or indirect service providers, the actual nature of their involvement varies among systems to reflect contextual differences.

Role of households in reproductive health service provision

The household participates both as a producer and a consumer of the services when its members undertake internally determined activities to maintain and/or recover good health. In the provision process the household acquires health education that enables its members to make appropriate choices to avoid activities that may lead to infections. For example, people reduce the number of sex partners when they learn about the high risk of infection with HIV if they maintain multiple sexual relationships. That way they keep the rate of infections down.

Programmes that entail community involvement rely on the participation of households, first as the hosts of the programme in the community social networks and organisation and second for providing some human resources needed to maintain the community process. The door-to-door MCH/FP programme of Bangladesh for instance is credited with having been responsible for 85 per cent distribution of all pills distributed in the rural areas by 1997. The programme used locally recruited and trained married women to distribute contraceptives from door to door (Phillips and Hossain, 2003; Routh and Khuda, 2000). Likewise, the CBD programme in Kenya was also accredited with contributing to declines in total fertility rates (TFR) from 8.1 in 1979 to 4.7 in the 1990s, and its disruption occasioned by shifts in donor priorities, is suspected to have contributed to stalling contraceptive prevalence (CPR) and rising TFR in the 2000s (KDHS, 2003; Koome *et al.*, 2006; Global Gag Rule Impact Project, 2006). But households are also the main consumers of RH services. The existence and magnitude of demand for such services in the household has some influence on the mix and magnitude of services provided through social marketing programmes, private market for-profit providers and government-sponsored facilities. Demographic and Health Surveys (DHSs) conducted in Africa now challenge the “weak demand” hypothesis and indicate that demand for FP services especially for purposes of spacing births exists often at levels far higher than expected, particularly when supply side weaknesses are corrected (Miller *et al.*, 1998).

The characterisation of the involvement of the household in both consumption and provision roles in the reproductive health scenario is determined and affected by contextual socioeconomic factors, which will vary by the context under review.

Hogan *et al.* (1999) establish that the use of contraception by women in southern Ethiopia is influenced and affected by, among others, the structure of the extended family and the size of the nuclear family; and education, which provides a woman with a wider array of information and greater access to modern, effective contraceptive methods. In the traditional Moroccan society, religion and culture often limit women's access to finance and restrict their ability to make their own health care decisions. Hotchkiss *et al.* (2005) determine that for a cost-sharing regime, the household may play a major role in the design of a proposed social insurance plan. (For isolation of more factors also see Bertrand *et al.*, 1984; Berman and Rose, 1996; and Cochrane and Guilkey 1992.)

Role of the private sector in RH service provision

Private sector participation involves two groups of independent RH service providers; group one comprises the private-for-profit hospitals and clinics and group two consists of non-profit NGOs that run hospitals, clinics and public health programmes. Private providers are an important source of services in many SSA countries and elsewhere in the world. The role of the private sector in the provision of reproductive health services depends in part on the extent to which the service (good) being provided is subject to market failures. A prediction of economic theory is that the less the good is subject to market failures, the more the private sector participates in its provision. For pure public goods, which are subject to considerable market failures, the role of the private sector may be limited (Berman and Rose, 1996). The theoretical derivative is confirmed by Berman and Rose (1996) from DHS data from 11 developing countries indicating that private sector use was lower for the more "public goods" with significant demand-side market failures, such as immunisation and family planning, and higher for more private goods such as treatment of childhood diseases. The generally poor economic conditions in SSA countries may limit private provision of RH services, even of illness treatment, through constraints to private demand and supply. Where incomes permit, however, as in Botswana where policies to assure public provision of service are in place, private provision may be limited.

In countries where state action is limited by either social-cultural factors or lack of funds, there is dominance of private provision of the RH service, for example, in family planning matters in Latin America, because of the Roman Catholic influence on contraceptive issues, the private provision responds to local demand conditions. Furthermore, not-for-profit providers may step in by viewing the provision of RH services as part of their mission, thereby contributing to a greater role of private provision for largely public goods (Berman and Rose, 1996). In West African countries, the introduction of family planning in any form, and the adoption of population policies by the government during the late 1980s and the 1990s, was at least partly due to the efforts of NGOs. In each country, the impetus was provided by an NGO that was or became an affiliate of the IPPF. NGOs in Ghana, Guinea and Côte d'Ivoire were not only involved in service provision in their own facilities,

but also directly supported FP service provision within government facilities, including supplying contraceptives and providing management, supervision and technical assistance (Stewart *et al.*, 1999). Examples from other countries include NGOs support to improve FP service provision by training medical personnel and community-based distributors. Organisations involved in training include IPPF and its affiliates in different countries. The Population Council and USAID cooperating agencies have also been involved in the development of tools for improving quality in service delivery; among these are the client-oriented provider-efficient (COPE) tool developed by Engender-Health using providers' self-assessment (RamaRao and Mohanam, 2003).

Role of government in RH service provision

Reproductive health services fall in the category of social services that economists call *quasi-public goods*. The consumption of the services is associated with pervasive social benefits of disease prevention, human capital enhancement and general improvement in the potential for increased productivity (Mwabu *et al.*, 2001). On the basis of the traditional social contract that governments of the developing world enter with their populations *to fight ignorance, disease and poverty*, the provision of RH services is dominated by the public sector. Adequacy of funds and effectiveness of programmes thus developed notwithstanding, tax revenues are always indicated in policy as the primary source finance. Even where the government is not the main provider, as in the private sector, it is expected to play the role of supervising and quality assurance.

In designing their RH programmes sector, and in the rationalisation of programmes in the past two decades of health sector reform, most African policy makers opted for the delivery of RH services within integrated health programmes (combining FP and MCH) more in line with the later endorsement by ICPD (Krasovec and Shaw, 2000). Decentralisation has become the commonest feature of institutional rearrangement during the health sector reform process. Decentralisation has been justified as a means of improving the efficiency of public spending. It relies on the participation of the community in order to achieve a better match of expenditures with local priorities and preferences (Ugaz, 2001). In most African countries in the 1990s, the vast majority of women (95 per cent in Botswana and 71 per cent in Kenya to a low of 43 per cent in Ghana) received modern FP from government sources rather than NGOs, pharmacies and private practitioners (Ross and Frankenberg, 1993), most frequently health facilities rather than CBD systems, which have been implemented on a much smaller scale in Africa (Miller *et al.*, 1998).

Review of Theoretical and Empirical Models

Reviewing theoretical and empirical models in the provision of RH services involves engaging in a discussion on the conceptual frameworks, perspectives and methodologies that guide the formulation of the programmes and interventions that

form the evaluation basis for relating interventions to results and effects. Literature on RH addresses separately or in combination at least three features of the evaluation of service provision:

Description of the interventions or programmes to show their structure, the principles that underlie the designs, programme components, and their functions and linkages with performance; Measurements of effectiveness of the programmes in relation to objectives that are normally couched in terms of the quantity and quality of services that are provided; and Assessment of availability, distribution and accessibility of services to all or segments of the population as preset by the programmes or intervention design.

Literature on the social provision of services like reproductive health care explores institutional and technological arrangements to obtain answers to the question of whether the operative arrangement is the most suitable to attain optimum technical and/or allocative efficiency. Specific questions on technical efficiency seek to find out whether the current organisational form and input set up will attain the maximum possible output or effectiveness at the lowest possible cost. Allocative efficiency questions try to establish who in the population is accessing the specified benefits out of the investment in its current format. They pose the questions of equity: for example, are the RH services provided in the present institutional arrangement adequate and are they reaching the target population segments that they were intended for (Mwabu *et al.*, 2001; Sanjay, 2001; RamaRao and Mohanam, 2003).

Four domains: quality; availability; accessibility; and utilisation of services, dominate discussions on service provision. The main assumption in respect of quality is that once technologies have been approved by the authorities (i.e., appropriateness, effectiveness, efficacy, and safety of substances), than the other issues of quality to consider are with the management and administration of the provision process. The socioeconomic context becomes the basis of building the models for understanding the issues within the four domains. The dominance and the differences in certain types of institutional framework designs and management approaches may be explained by variations in the social and economic circumstances facing each country or region. Among the circumstances to consider is the extent of the dominance of cultural traditions on the RH value system. For example, the details of the institutions will differ between a society where traditions deny women and youth decision making power on accessing types and sources of RH services and a society where the opposite is the case. The society where a non-cash economy prevails will exhibit the need for government dominated institutions more than a society where the subsistence economy is small relative to the modern economy (RamaRao and Mohanam, 2003).

The model that is specified for individual systems or interventions will further exemplify the bias of the scientific discipline approach and the peculiar circumstances of the system. In family planning, estimates of couple-years of

protection (CYPs) are used to assess the performance of contraceptive delivery programmes. Stewart *et al.* (1999) use CYPs as a measure of the importance of vertical and integrated organisation structures in West Africa. Their results emphasise the central role of vertically structured programmes for these countries. With the exception of Nigeria, where a clear majority of family planning visits occur in government-run, largely integrated facilities, either a majority or very large proportion of total family planning CYPs is provided by NGOs or through social marketing or community-based distribution systems. Stewart *et al.* conclude that the result may not necessarily indicate the superiority of one organisation set up over the other. The relative merit of one approach may depend on the social, economic and political environment, thus optimal programme structure may depend on the local situation.

Amadeo *et al.* (1991) provide an economic perspective of the Profamilia Family Planning Programme in Colombia. The basic model questions are whether and how the programme might do better with the available resources, or alternatively how and where it might allocate resources to maximise the contraceptive protection it offers. The study examines efficiency in operations, which calls for production of maximum contraceptive protection subject to internal and allocative efficiencies. *Internal efficiency* relates to unit costs of protection for a given method mix. This concerns which of the inputs (e.g., nurses) and worker attributes (age, sex, experience) should be expanded at the margin possibly at the expense of others, in order to increase the efficiency within each subprogramme or part of it. *Allocative efficiency* relates to the questions of which subprogramme or method additional funds should be allocated to. Allocative questions stem from varying levels of efficacy (in terms of couple-years of protection), cost-recovery potential (in terms of prices of fees relative to cost) and different consumer demand patterns (in terms of age of users of particular programmes/methods). As they examine the factors that contribute to the utilisation of reproductive health care in the Kenyan health care system Muia *et al.* (2003) provide conceptual framework that links the health care system to desired maternal health outcomes.

The factors are grouped into three categories:

Contextual determinants: Government commitment, policies, resources, sociocultural environment, gender issues, individual and family characteristics; *Intermediate determinants:* Accessibility and availability of services; physical, financial and socio-cultural, health behaviour; general behaviour; and *Proximate determinants:* Use of quality maternal health services, family planning, antenatal care, clean and safe delivery, essential obstetrics. (For other model specifications see also Hogan *et al.*, 1999; Sananikhom *et al.*, 2000; Askew and Khan, 1990; Krasovec and Shaw, 2000.)

The Appendix provides a summary of additional illustrations of evaluative case studies of RH care programmes. The RH service provision models developed in this chapter form the basis of six case study provision models, evaluation questions,

evaluation parameters, evaluation models and abbreviated findings. The first case study, by Seiber *et al.* (2005), evaluates the provision of MCH/FP services in Guatemala and looks at the efficiency implications of service integration. In the second case study, Routh and Khuda (2000) conduct an economic appraisal of alternative strategies for the delivery of MCH/FP services in urban Dhaka, Bangladesh, while Stewart *et al.* (1999), examine integration in respect to family planning programme structures and performance in West Africa. The fourth case study, by Amandeo *et al.* (1991) examines the resource efficiency question for a national NGO family planning programme in Colombia. In the fifth case study, Katende *et al.* (2003) examine the organisational effectiveness of facility-level RH interventions and contraceptive use in Uganda. The sixth case study by Agha (2002), assesses the impact of four adolescent sexual and reproductive health interventions in sub-Saharan Africa (Cameroon, Botswana, Guinea and South Africa).

Topical issues of Concern

Many health care delivery systems in low-income countries are based on a centrally planned and financed system. In recent years, organisational changes have been introduced into many such systems. These changes (decentralisation, privatisation, integration and sector-wide approaches) substantially alter the way the system operates and affects RH care provision (Ensor and Ronoh, 2005). In the previous section, we delineated theoretically possible reproductive health service provision models through combinations of providers, organisational forms, management systems and delivery modes (Figure 4.1). The service provision model notwithstanding, there are certain features that promote as well as hinder access and uptake of reproductive health services. The factors constituted the explanatory feature of the performance inquiry models discussed in the last section. The following discussion therefore refers to the respective service provision model in which the features are inherent.

Features that Promote Access and Uptake of RHS

Quite a number of features of service provision models have stood out in their ability to promote access and uptake of RH services. Among these are good quality of care including provider attitudes; comprehensiveness of services; and the effectiveness and efficiency of resource use. Organisational autonomy also seems to improve access, as does recognising the diversity of various target groups. Flexibility of programmes in integrating new services is another factor. Access is also enhanced when programmes initiate promotional activities and involve stakeholders. Finally, important factors in improving access are the cost of services and the convenience of the location of the facility/provider.

Good quality RH services require the presence of trained personnel in well-equipped clinics where clients are treated courteously and provided with a variety

of appropriate services (RamaRao and Mohanam, 2003). Literature suggests that the good quality of care results in such positive outcomes as client's satisfaction, increased knowledge, and more effective and longer use of contraceptives (RamaRao and Mohanam, 2003). Adam *et al.* (2005) state that the quality of services in the clinic-based model is good because of the timely aversion of deaths, early recognition and treatment of complications, and timely referral for complex care. Clinic-based care encourages continued use of contraceptives and offers the possibilities of introduction to new family planning methods (Bertrand and Brown, 1992). Ensor and Ronoh (2005) note that decentralisation can also improve the provision of services by offering them at a higher level of quality.

Integrated service delivery models are regarded as a way to offer more comprehensive health services to better meet client's needs (Katz *et al.*, 1998). Integrated models are also viewed as a cost-effective means of reaching a large proportion of the population with information and services (Miller *et al.*, 1998; Ensor and Ronoh, 2005). Clinic-based programmes offer a wider range of contraceptive methods than other service delivery mechanisms because they provide methods that can be administered only by clinical personnel and as non-clinical methods (Miller *et al.*, 1998, Adam *et al.*, 2005). This suggests that providing integrated RH services at clinics promotes access and higher coverage of the population.

Programmes with features conducive to effectiveness and efficiency in resource use also promote access and uptake of RH services. Adam *et al.* (2005) illustrate that packages of integrated maternal and newborn interventions are more cost-effective than individual (vertical) interventions because of synergies on costs. This suggests that integrated programmes enhance effectiveness and technical and allocative efficiency in resource use (Levine *et al.*, 2006). Integration ensures wider coverage and maximises economies of scale. It has been established that clinic based interventions (Katz *et al.*, 1998) and those at community and primary care levels (Adam *et al.* 2005; Katz *et al.*, 1998) are highly cost-effective.

Recognition of diversity of needs of various groups and flexibility of programmes in integrating new services can be found in community-based models and in both integrated and vertical programmes. The community-based model has been used to reach populations whose access to family planning services would otherwise be limited (Katz *et al.*, 1998). Its feature of using workers who live in or visit the communities encourages improved access and increased contraceptive prevalence. The basis of integrating family planning with other reproductive health services is the recognition that women's health needs are in no way confined to contraception. Community-based and integrated models of delivery recognise the diversity of various target groups in terms of service needs and exhibit flexibility in introducing new services. Vertical programmes such as small NGOs with localised areas of operation can be very flexible in adapting programmes to their clients' needs and they also have greater impact in sensitive areas of reproductive health such as

adolescent issues and gender-based violence (Hardee *et al.*, 1999), thereby recognising the needs of various target groups.

Service provision models such as social marketing that have promotional activities, including behaviour change and delivery of clinical services through social franchises, increase contraceptive use (Levine *et al.*, 2006). Since social marketing programmes use existing commercial outlets (no need to build own distribution networks), they enjoy lower costs per output thereby increasing contraceptive sales (Levine *et al.*, 2006).

Consultation and involvement of communities, as in community-based models, can lead to wider acceptance of programmes and thereby encourage higher levels of service use. Ensor and Cooper (2002) report that a review of community-based distribution in Africa suggested a positive impact on contraceptive prevalence. They note that schemes that consulted widely with community representatives and stakeholders tended to be more successful.

Provision models where the cost of obtaining service is significant may discourage use. Economic access to services (only one aspect of access) is the extent to which the cost of reaching service delivery or supply points and obtaining contraceptive services and supplies is within the economic means of a large majority of the target population (Bertrand *et al.*, 1995). Ensor and Cooper (2002) consider the cost of obtaining a service to be a complex of the direct price paid for the service, the distance cost to the service, the time or opportunity cost required, and other informal payments made to facility staff for commodities. It is vital to understand the nature, extent and impact of the costs associated with various provision models.

Integrated reproductive health services have the positive externality that clients seeking a specific service have a higher likelihood of having other needs attended to because services are conveniently available. For example, integrating STI with FP services can both help identify women who wish to avoid risky pregnancy and prevent foetal and neonatal complications (Levine *et al.*, 2006). The success of the community-based models in Bangladesh and Kenya has been attributed to the strategy of taking supplies and advice to the “doorstep” of eligible couples (Ensor and Cooper, 2002; Karanja, 2006; Koome *et al.*, 2006; Global Gag Rule Impact Project, 2006). Convenience of service availability can be found with community-based models and integrated programmes, as well as clinic-based models.

Features that Hinder Access to and Uptake of RHS

Other aspects of service provision models can hinder access and uptake of RH services. Amongst those identified from the literature are: inadequate range of services, supervisory and management problems, lack of client focus by service providers, and poor targeting of services. A significant barrier is a delivery system marked by a lack of adequately trained personnel. Other constraints arise from funding problems and poor resource mobilisation; poor coordination amongst stakeholders, providers and funding agencies; lack of adequate attention to some

components of integrated services; and the inability to address equity issues and discriminate users by ability to afford services. Significant hindrances are costs of accessing the services and poor quality of services.

Although Bangladesh's government-run community-based family planning delivery system was associated with successes, it did not include child or reproductive health (Phillips and Hossain, 2003). This indicates lack of comprehensiveness and inadequate range of services in the CBD model. A notable weakness with community-based models is that efforts to engage communities often serve to empower socially conservative elites and local groups to the exclusion of issues related to women's reproductive health needs and the treatment of poor people (Mayhew *et al.*, 2004; Phillips and Hossain, 2003). Other weaknesses of the CBD model are related to training, supervisory and management problems that may affect the quality of services and the focus on women rather than couples, which thereby limits the range of services offered (Phillips and Hossain, 2003). These weaknesses reduce the efficiency of the outreach services.

Without adequately trained personnel, it may be difficult to offer high quality integrated RH services, as was observed in Bangladesh, India, Nepal and Peru among other countries by Hardee *et al.* (1999). One NGO in Peru remarked that "the nurse is required to be a lawyer, psychologist and social worker all in one, but she receives no training to deal with all these roles" (p. S8). This affects the quality of services offered and can also discourage demand. Staffing shortages and high staff turnover were reported as constraints to service delivery in primary health care centres in Jamaica (Hardee *et al.*, 1999).

Funding problems can be a major constraint to service use and provision. Nahar and Costello (1998) reveal that there are considerable hidden costs in the "free" clinic-based maternity care in Bangladesh. The authors regard this as a major contributor to low utilisation of maternity services, especially among low income groups. Therefore, where costs of accessing the service are high, uptake may be compromised. In terms of provision, lack of adequate funds limits the services on offer. For example, it was reported that in Jamaica (Hardee *et al.*, 1999), the government provided no extra funding for reproductive health services outside the budget of primary health care, limiting the amount of services that could be offered. The shifts in global funding and the policy known as the "global gag rule", which prohibits US government funding of any organisations and programmes that may provide or support abortion even though they provide other RH services, has reduced the funds available for FP provision. The withdrawal of funds from FP services because of the gag rule has also affected the provision of other components of RH services especially where provision is integrated (Karanja *et al.*, 2006; Koome *et al.*, 2006; Global Gag Rule Impact Project, 2006).

In describing efforts to integrate reproductive health services in several countries in Asia, the Middle East, Africa and Latin America, Hardee *et al.* (1999) note that coordination is poor and there is no clear division of the roles of the government,

other providers and donors. Needless to say, this confusion has a negative impact on service provision and adversely affects access and uptake.

Acknowledging the role of private sector provision in increasing the use of sexual and reproductive health (SRH) services Mayhew *et al.* (2004) recognise that social marketing can increase awareness and acceptance of services. They point out, however, that this approach is criticised on the basis that selling a product (e.g., contraception) is not the same as providing a full range of services associated with that product (e.g., counselling on sexuality, pregnancy and STI/HIV risk). This suggests that the social marketing model fails in adopting a holistic approach to service provision.

The clinic-based model suffers the inability to discriminate between clients from different socioeconomic backgrounds, especially the poor who are in dire need of RH services. Rani and Lule (2004) demonstrate that clinic-based programmes may have little impact on SRH issues of poor youth and disadvantaged women. This may in part be due to lack of funds to pay for care, as well as the geographic barriers that inhibit access to clinics by the poor. Clinics also have an element of social distance between poor clients and health care professionals. The authors suggest that the appropriate delivery models for the poorest sections of the population may include community-based outreach programmes that target special groups, e.g., poor young women and focus on particular regions. Community-based models, although effective in reaching the disadvantaged segments of the population, are more expensive and may not be justified as cost-effective (Rani and Lule, 2004).

The issue of quality features prominently as an aspect of RH services that can discourage their uptake. Access to high quality FP and RH services including control of STIs is a central and growing concern in SSA (Miller *et al.*, 1998). There is burgeoning evidence that public health systems frequently do not deliver good quality basic services targeted at the poor (Ensor and Ronoh, 2005). This is also demonstrated in Bangladesh where clients indicated receiving higher quality services from NGO clinics and private providers than from government sources (Hardee *et al.*, 1999). Despite the unmet needs in FP and RH services in SSA, the services that do exist in the region are underutilised and Miller *et al.* (1998) hypothesise that this conflict between need and practice is the poor quality of the services that are offered, among other reasons. A situation analysis of 11 African countries revealed major weaknesses in the availability, functioning and quality of family planning services, indicating substantial opportunities for strengthening the quality of care (Miller *et al.*, 1998).

Challenges of Provision Models

Efforts to integrate FP with MCH started as early as the mid 1970s. Yet FP, like infant health, has often received more attention than maternal health as reflected in the steadily improving contraception prevalence rates and declining infant mortality

alongside continuing high maternal mortality and morbidity. In some countries, although maternity mortality has fallen as a result of increased contraceptive use, deaths from complications of wanted pregnancies and unsafe abortions have remained high (Berer, 2003). The literature attests to the fact that a number of components of SRH services are still excluded from integrated SRH service programmes. Among these are fertility awareness education, especially for young people; breastfeeding education and support, including for replacement feeding for HIV-positive women; and family planning services for older, single, widowed and divorced/separated women and men, sex workers and their clients, and other marginalised groups. Often missing, as well, are services catering specifically for young people, including family planning, STI education and treatment, sexuality education, life skills training, and help in coping with stress and depression. Other services that may be lacking are safe abortion services (including both medical and surgical methods); postpartum and post-abortion care that includes contraceptive services; and female sterilisation and vasectomy (Berer, 2003). The challenge for provision models remains to provide SRH as expounded in the ICPD definition.

Noting that implementation of integrated reproductive health programmes as advocated in Cairo (Mayhew *et al.*, 2004) was limited in many countries, Hardee *et al.* (1999) highlight a number of challenges that hamper integration. These include non-consideration of the complexity of administration and service integration, which requires careful planning from the national ministry down to the smallest health post, and not recognising that integrating the services at the same time that their management and financing are decentralised exacerbated the complexities of both activities. Among other challenges are institutional constraints and coordination problems among organisations, which often impede progress, as well as confusion in organisational roles and responsibilities. For example, donor competition to fund and emphasise different aspects of reproductive health may shift the programme focus to concentrate on areas for which the money is available. Recent shift of international funding to HIV/AIDS has resulted in the reduction of funds for CBD as an activity of FP. Many FBOs and CBOs are concentrating on HIV/AIDS programme activities at the expense of other RH activities at the community level. A further response in shifts to the emphasis may require adjustment to the provision model, either to emphasise more facility- or community-based delivery modes as the situation may require. Finally, there are constraints like human resource challenges such as shortages, work overloads, lack of trained providers, and poor quality of care.

Lack of a health systems approach as well as of a clear understanding of the meaning of integration is another important reason why integration sometimes fails. For example, despite the integration of primary health care services, budgeting and funding have traditionally been left, by the sexual and reproductive health field, to someone else (Berer, 2003), indicating lack of coordination in the organisation of service provision. Hardee *et al.* (1999) cite examples from several countries in Asia, the Middle East, Africa and Latin America and their experiences at integrating RH

services. Most note challenges related to lack of adequately trained personnel to take on new roles, lack of coordination between providers and funding agencies, and lack of clear guidelines and implementation policies on integration of services (Hardee *et al.*, 1999; Mayhew *et al.*, 2004). For example, referring to the change from doorstep delivery to integrated static clinic delivery of contraceptives in Bangladesh, Hardee *et al.* (1999) point out the difficulties in integrating the directories of the different providers, this is because each had its own vertical delivery structures and rarely coordinated efforts with others and there was little political will to force integration.

For most poor SSA countries, major challenges towards integration of services may revolve around the preparedness of the country's system to add new services or focus on SRH services. For example, Hardee *et al.* (1999) note that focusing on RH services in Nepal was inappropriate given the government's inability to provide even the most basic health care and that there were insufficient funds to embark on expanding SRH services.

The move from centralised to decentralised management systems is viewed as one way of improving efficiency in resource use and service provision. But a number of challenges face efforts to decentralise. Ensor and Ronoh (2005) observe that where guidelines are not in place and there is no clear policy on RH service provision, decentralisation can lead to lower priority being placed on reproductive health (in relation to other health services and social sectors) resulting in resource deficiencies and poor integration of RH service into the wider health system. This was also demonstrated in Ghana by Hardee *et al.* (1999), who indicate the risk that priority on SRH issues in particular, and health issues in general may drop because of the many causes competing for the same resources. Berer (2003) cautions that with the changes in the financing of health care, including the sector-wide approach, it is no longer certain that services the field considers essential, including family planning, will still get priority or sufficient funding. It is therefore important to devise ways of reaping the benefits of decentralisation without trading off the goal of increasing access and uptake of SRH services, ensuring that they receive sufficient priority by way of funding and provision. Lack of support systems for the optimal capacity required to manage complex health services can diminish possible gains from decentralisation. These systems can be in terms of political will and support, along with capacity at lower levels to undertake new roles such as supervision, as well as consideration of supportive changes in related ministries and sectors (Ensor and Ronoh, 2005).

Considering the SSA poverty situation, the private provision of SRH services deserves careful consideration. Some components of sexual and reproductive health services are public goods in nature and the private sector may not be best suited for their provision. Ensor and Ronoh (2005) provide evidence revealing that private provision can lead to a skewed pattern of maternal health services (i.e., service selection by ability to pay) associated with induced demand by the physicians rather than the users of service. Private provision is often viewed as having harmful

effects on SRH services especially because private out-of-pocket payments have more impact on vulnerable groups. The question of how poverty affects and drives the design of SRH provision models and the subsequent access and uptake of services deserves investigation. Other challenges related to private provision involve lack of comprehensiveness of services. For example, a challenge that was noted in the Jamaican system was that the network of private providers of reproductive health services does not serve the needs of adolescents and men particularly well (Hardee *et al.*, 1999).

Conclusions

Our extensive review of the literature on the social provision of RH services has revealed that the organisational scheme presented in Figure 4.1 is a generic form that all systems adopt their service delivery set-ups from. The dominance and the differences in certain types of institutional framework designs and management approaches may be explained by variations in the socio-cultural and economic circumstances facing each country or region. Some of the social and economic circumstances to consider are the extent of dominance of the cultural traditions on the value system in regard to RH. Social provision systems are engaged in making choices of which services to put on vertical or integrated organisational forms and which management systems either centralised to adopt or decentralised. Health sector reform practice during the last two decades has been dominated by the move towards decentralised and integrated programmes of service delivery. At the operational level it is observed that there exist many variants of three main delivery modes: community based, social marketing and facility based.

Classification of service provision systems in the literature does not fall neatly into the scheme of Figure 4.1. This presents a difficulty in conducting comparative evaluation studies on the performance of different variants of the provision models to determine cost and effectiveness, efficiency, and equity. A clear classification of systems further enables a more detailed comparison to include population characteristics, environmental factors and programmatic features in understanding the processes of RH service access, availability, affordability, acceptability and utilisation.

The following discussion captures some of the main issues in the literature that require further research to support improvements in policy design and interventions for promoting the use of RH services:

Although the logic of integration is compelling, little research has been done on the costs of integrated programmes; there appears to be a paucity of studies examining the influence of centralised versus decentralised models of service provision on the access and uptake of RH services; Issues of how to reach adolescents through cost-effective interventions are of high research priority. Also of high priority is how to stimulate demand for familyplanning in SSA countries, where demand is relatively low; Further research is required to understand how provision processes affect the

relationship between fertility and other reproductive health outcomes and economic outcomes at micro and macro levels. Such research could include, for example, how access to contraceptives may affect women's productivity as well as human capital investments in the next generation. More attention needs to be paid to the cost and cost-effectiveness of community-based programmes, especially because of the popularity of community involvement in the new intervention designs.

Notes

1. ICPD represented a new paradigm for sexual and reproductive health. It shifted the emphasis of reproductive health from population control to the promotion of a holistic view of the sexual and reproductive health of individuals, enshrining these in human rights language and advocating for improved service delivery through integrated, client-centred and empowerment approaches (Mayhew *et al.*, 2004). To date, 178 countries have adopted the Programme of Action of the ICPD, or what is commonly referred to as the Cairo Agenda (Krasovec and Shaw, 2000).
2. The term different providers in this context, assumes a subset of providers and excludes the possibility that it includes all providers. For example, MOH and FHOK (Family Health Options Kenya, formerly FPAK – Family Planning Association of Kenya, an NGO) may be such a subset that excludes others.

References

- Adam, T., S.S. Lim, S. Hehta, Z.A. Bhutta, H. Fogstad, M. Mathai, J. Zupan and G.L. Darmstadt. 2005. "Cost effectiveness analysis of strategies for maternal and neonatal health in developing countries". *BMJ*, 331: 1107–12.
- Agha, S. 2002. "A quasi-experimental study to assess the impact of four adolescent sexual health interventions in Sub-Saharan Africa". *International Family Planning Perspectives*, 28 (2): 67–70 and 113–8.
- Amadeo, J., D. Chernichorsky and G. Ojeda. 1991. "The Profamilia Family Planning Program, Colombia". World Bank Policy Research and External Affairs Working Paper No. 759. The World Bank, Washington, D.C.
- Appleton, Simon. 2001. "User fees, expenditure restructuring and voucher system in education". In Germano Mwabu, Cecilia Ugaz and Gordon White, eds., *Social Provision in Low-Income Countries*. United Nations University. New York: Oxford University Press.
- Aral, S.O. and M. Over. 2006. "Sexually transmitted infections". In D.T. Jamison, J.G. Breman, A.R. Measham, G. Alleyne, M. Claeson, D.B. Evans, P. Jha, A. Mills and P. Musgrove, eds, *Disease Control Priorities in Developing Countries*, 2nd Edition. New York: Oxford University Press and The World Bank.
- Askew, I. and A.R. Khan. 1990. "Community participation in national family planning programs: Some organisational issues". *Studies in Family Planning*, 21 (3): 127–42.
- Berer, M. 2003. "Integration of sexual and reproductive health services: A health sector priority". *Reproductive Health Matters*, 11 (21): 6–15.

- Berer, M. 2004. "HIV/AIDS, sexual and reproductive health: Intersections and implications for national programmes". *Health Policy and Planning*, 19 (Supplement 1): i62–i70.
- Berman, P. and L. Rose. 1996. "The role of private providers in maternal and child health and family planning services in developing countries". *Health Policy and Planning*, 11 (2): 142–55.
- Bertrand, J.T. and J.E. Brown. 1992. "Family planning success in two cities in Zaire". World Bank Policy Research Working Paper No. 1042. The World Bank, Washington, D.C.
- Bertrand, J.T., N. Mangani and M. Mansilu. 1984. "The acceptability of household distribution of contraceptives in Zaire". *International Family Planning Perspectives*, 10 (1): 21–6.
- Bertrand, J.T., K. Hardee, R.J. Magnani and M.A. Angle. 1995. "Access, quality of care and medical barriers in family planning programs". *International Family Planning Perspectives*, (21) 2: 64–69+74.
- Birungi H., P. Nyarko I. Askew, A. Ajayi, F. Addai, G. Addico and Jehu Appiah. 2006. *Priority Setting for Reproductive Health at the District Level in the Context of Health Sector Reforms in Ghana*. Population Council, MOH/Ghana, UNFPA/Ghana and Ghana Health Service.
- Bratt, J.H., M.A. Weaver, J. Foreit, T. De Vargas and J. Barbara. 2002. "The impact of price changes on demand for family planning and reproductive health services in Ecuador". *Health Policy and Planning*, 17 (3): 281–87.
- Chakraborty, N., M.A. Islam, R.I. Chowdhury, W. Bari and H.H. Akhter. 2003. "Determinants of the use of maternal health services in rural Bangladesh". *Health Promotion International*, 18 (4): 327–37.
- Clay, D.C., and J.E. Vander Haar. 1993. "Patterns of intergenerational support and childbearing in the third world". *Population Studies*, 47 (1): 67–83.
- Cochrane, S. and D.K. Guilkey. 1992. "How access to contraception affects fertility and contraceptive use in Tunisia". World Bank Policy Research Working Paper No. 841. The World Bank, Washington, D.C.
- Ensor, T. and S. Cooper. 2002. "Resource allocation and purchasing: Influencing the demand side". Draft Report Prepared for World Bank Resource Allocation and Purchasing (RAP) Project. The World Bank, Washington, D.C.
- Ensor, T. and J. Ronoh. 2005. "Impact of organisational change on the delivery of reproductive services: A review of the literature". *International Journal of Health Planning Management*, 20: 209–25.
- Ensor, T., P. Dave-Sen, L. Ali, A. Hossain, S.A. Begum and H. Moral. 2002. "Do essential service package benefit the poor? Preliminary evidence from Bangladesh". *Health Policy and Planning*, 17 (3): 247–56.
- Fapohunda, E.R. and M.P. Todaro. 1998. "Family structure, implicit contracts and the demand for children in southern Nigeria". *Population and Development Review*, 14 (4): 571–94.

- Freedman, R. and B. Berelson. 1976. "The record of family planning programs". *Studies in Family Planning*, 71: 1–40.
- Global Gag Rule Impact Project. 2006. "Access denied: Impact of the Global Gag Rule in Kenya". The Global Gag Rule Impact Project, A joint collaborative research effort by Population Action International, Planned Parenthood Federation of America, Inc., International Planned Parenthood Federation (IPPF), *Ipas*, Pathfinder International and Engenderhealth. Nairobi, Kenya. Accessed from www.globalgagrule.org.
- Graham, W.J., J. Cairns, S. Bhattacharya, C.H.W. Bullough, Z. Quayyum and K. Rogo. 2006. "Maternal and perinatal conditions". In D.T. Jamison, J.G. Breman, A.R. Measham, G. Alleyne, M. Claeson, D.B. Evans, P. Jha, A. Mills and P. Musgrove, eds., *Disease Control Priorities in Developing Countries*, 2nd Edition. New York: Oxford University Press and The World Bank.
- Hardee, K. and J. Smith. 2000. "Implementing reproductive health services in an era of health sector reform". A publication of the POLICY Project. Futures Group International in collaboration with Research Triangle Institute and The Centre for Development and Population Activities, with the support of the U.S. Agency for International Development (USAID), Washington, DC.
- Hardee, K., K. Agarwal, N. Luke, E. Wilson, M. Pendzich, M. Farrell and H. Cross. 1999. "Reproductive health policies and programs in eight countries: Progress since Cairo". *International Family Planning Perspectives*, 25, Supplement: S2–S9.
- Hennink, M., E. Zulu and F. Dodoo. 2001. "Effective delivery of reproductive health services to men: A review study in Kenya and Malawi, opportunities and choices". Working Paper No. 4. University of Southampton, UK.
- Hogan, D.P., B. Berhanu and A. Hailemariam. 1999. "Household organisation, women's autonomy, and contraceptive behaviour in southern Ethiopia". *Studies in Family Planning*, 30 (4, Dec): 302–14.
- Hotchkiss, D.R., K. Krasovec, M.D.Z. El-Idrissi, E. Eckert and A.M. Karim. 2005. "The role of user charges and structural health services in Morocco". *International Journal of Health Planning and Management*, 20: 113–35.
- Huff-Rouselle, M. and H. Pickering. 2001. Crossing the public-private sector divide with reproductive health in Cambodia: Outpatient services in a local NGO and the national MCH clinic". *International Journal of Health Planning and Management*. 16: 33–46.
- Huntington, D. and L. Nawar. 2003. "Moving from research to program – The Egyptian post-abortion care initiative". *International Family Planning Perspectives*, 29 (3): 121–25.
- Jing, F. 2004. "Health sector reform and reproductive health services in poor rural China". *Health Policy and Planning*, 19 (Supplement 1): i40–i49.
- Kamau, A.W. 2006. "Factors influencing access and utilisation of preventive reproductive health services by adolescents in Kenya. A case study of Muranga District". PhD Dissertation, University of Bielefeld, Germany.
- Karanja, J., P. Njoroge and S. Orero. 2006. "Impact of trends in community based family planning on contraceptive prevalence rate". In NCAPD and MEASURE Evaluation,

- A Closer Look at KDHS 2003: Further Analysis of the Contraceptive Prevalence and Fertility Stalls – Summaries of Selected NCAPD Working Papers 2005*. National Coordinating Agency for Population and Development, Nairobi, Kenya.
- Koome, P., D. Nturbi and G. Kichamu. 2006. "The effect of declining family planning IEC efforts on contraceptive behaviour". In NCAPD and MEASURE Evaluation, *A Closer Look at KDHS 2003: Further Analysis of the Contraceptive Prevalence and Fertility Stalls – Summaries of Selected NCAPD Working Papers 2005*. National Coordinating Agency for Population and Development, Nairobi, Kenya.
- Katende, C., N. Gupta and R. Bessinger. 2003. "Facility-level reproductive health interventions and contraceptive use in Uganda". *International Family Planning Perspectives*, 29 (3): 130–37.
- Katz, K.R., C.G. West, F. Doumbia and F. Kane. 1998. "Increasing access to family planning services in rural Mali through community-based distribution". *International Family Planning Perspectives*, 24 (3): 104–10.
- Keller, A. 1991. "Management information systems in maternal and child health/family planning programs: A multi-country analysis". *Studies in Family Planning*, 22 (1): 19–30.
- Kowalewski, M., P. Mujinja and A. Jahn. 2002. "Can mothers afford maternal health care costs? User costs of maternity services in rural Tanzania". *African Journal of Reproductive Health*, 6 (1): 65–73.
- Krasovec, K. and R.P. Shaw. 2000. "Reproductive health and health sector reform. Linking outcomes to action". World Bank Institute, Washington, D.C.
- Lawn, J.E., J. Zupan, G. Begkoyian and R. Knippenberg. 2006. "Newborn survival". In *Disease Control Priorities in Developing Countries*. 2nd Edition, eds. Jamison, D. T., Breman, J. G., Measham, A. R., Alleyne, G., Claeson, M., Evans, D. B., Jha, P., Mills, A. and Musgrove, P. Oxford University Press and The World Bank.
- Levine, R., Langer, A., Birdsall, N., Matheny, G., Wright, M. and Bayer, A. 2006. Contraception. In D.T. Jamison, J.G. Breman, A.R. Measham, G. Alleyne, M. Claeson, D.B. Evans, P. Jha, A. Mills and P. Musgrove, eds, *Disease Control Priorities in Developing Countries*, 2nd Edition. New York: Oxford University Press and The World Bank.
- Lindberg, L.D., J.J. Frost, C. Sten and C. Dailard. 2006. "The provision and funding of contraceptive services at publicly funded family planning agencies: 1995–2003". *Perspectives on Sexual and Reproductive Health*, 38 (1): 37–45.
- Lule, E., J.E. Rosen, S. Singh, J.C. Knowles J.R. and Behrman. 2006. "Adolescent health programs". In D.T. Jamison, J.G. Breman, A.R. Measham, G. Alleyne, M. Claeson, D.B. Evans, P. Jha, A. Mills and P. Musgrove, eds, *Disease Control Priorities in Developing Countries*, 2nd Edition. New York: Oxford University Press and The World Bank.
- Maguire, E.S., A.A Way and M. Ayad. 1982. "The delivery and use of contraceptive services in rural Tunisia". *International Family Planning Perspectives*, 8 (3): 96–101.

- Mayhew, S. and S. Adjei. 2004. "Sexual and reproductive health: Challenges for priority-setting in Ghana's health reforms". *Health Policy and Planning*, 19 (Supplement 1): i50–i61.
- Mayhew, S.H., N. Gerein, A. Green and J. Cleland. 2004. "Improving health systems and enhancing reproductive health: Linkages and lessons for action". *Health Policy and Planning*, 19 (Supplement 1): i1–i4.
- Meekers, D. and S. Rahaim. 2005. "The importance of socio-economic context for social marketing models for improving reproductive health: Evidence from 555 years of program experience". *BMC Public Health*, 5 (10). Published online 27 January 2005 and available from <http://www.biomedcentral.com/1471-2458/5/10>.
- Mensch, B., A. Fisher, I. Askew and A. Ajayi. 1994. "Using situation analysis data to assess the functioning of family planning clinics in Nigeria, Tanzania, and Zimbabwe". *Studies in Family Planning*, 25 (1, Jan–Feb): 18–31.
- Miller, K., R. Miller, I. Askew, M.C. Horn and L. Ndhlovu. 1998. *Clinic-Based Family Planning and Reproductive Health Services in Africa: Findings from Situation Analysis Studies*. New York: The Population Council.
- Mugisha, F., H. Birungi and I. Askew. 2005. "Are reproductive health NGOs in Uganda able to engage in the health SWAp?" *International Journal of Health Planning and Management*, 20: 227–38.
- Muia, E., P. Ndavi, J. Olenja, P. Kizito, S. Curtis and A. Hyslop. 2003. *Factors That Contribute to the Utilisation of Quality Reproductive Health Care: Findings from Further Analysis of the Kenya Service Provision Assessment of 1999*. Nairobi, Kenya: National Council for Population and Development.
- Mwabu, G. 2001. "User charges for health care: A review of the underlying theory and assumptions". In G. Mwabu, C. Ugaz and G. White, eds., *Social Provision in Low-Income Countries*. United Nations University. New York: Oxford University Press.
- Mwabu, G., C. Ugaz and G. White, Eds. 2001. *Social Provision in Low-Income Countries*. United Nations University. New York: Oxford University Press.
- Nahar, S. and A. Costello. 1998. "The hidden cost of 'free' maternity care in Dhaka, Bangladesh". *Health Policy and Planning*, 13 (4): 417–22.
- PHR_{plus}. 2004. "MHOs and reproductive health: Using mutual health organisations to promote reproductive health". Partners for Health Reform_{plus} (PHR_{plus}). Abt Associates Inc., Bethesda, Maryland, USA.
- Phillips, J.F. and M.B. Hossain. 2003. "The impact of household delivery of family planning services on women's status in Bangladesh". *International Family Planning Perspectives*, 29 (3): 138–45.
- Phillips, J.F., W.S. Stinson, S. Bhatia, M. Rahman and J. Chakraborty. 1998. "The demographic impact of the family planning-health services project in Matlab, Bangladesh". In J.R. Foreit and T. Frejka, eds., *Family Planning Operations Research – A Book of Readings*. New York: The Population Council.
- Price, N. 2001. "The performance of social marketing in reaching the poor and vulnerable in AIDS control programmes". *Health Policy and Planning*, 16 (3): 231–39.

- RamaRao, S. and R. Mohanam. 2003. "The quality of family planning programs: Concepts, measurements, interventions, and effects". *Studies in Family Planning*, 34 (4): 227–48.
- Rani, M. and E. Lule. 2004. "Exploring the socioeconomic dimension of adolescent reproductive health: A multicountry analysis". *International Family Planning Perspectives*, 30 (3): 110–17.
- Ronsmans, C., J.F. Etard, G. Walren, L. Hoj, A. Dumont, L. de Bernis and B. Kodio. 2003. "Maternal mortality and access to obstetric services in West Africa". *Tropical Medicine and International Health*, 8 (10): 940–48.
- Ross, J. and E. Frankenberg. 1993. *Findings from Two Decades of Family Planning Research*. New York: The Population Council.
- Routh, S. and B. Khuda. 2000. "An economic appraisal of alternative strategies for the delivery of MCH-FP services in Urban Dhaka, Bangladesh". *International Journal of Health Planning and Management*, 15: 115–32.
- Sananikhom, P., I. Reerink, P. Fajans, C. Elias, and J. Satia. 2000. "Strategic assessment of reproductive health in the Lao People's Democratic Republic". *Asia-Pacific Population Journal*, 15 (4): 21–38.
- Sanjay Reddy. 2001. "Strategies for social provision: Key design issues". In Germano Mwabu, Cecilia Ugaz and Gordon White, eds., *Social Provision in Low-Income Countries*. United Nations University. New York: Oxford University Press.
- Schuler, S.R., L.M. Bates and M.K. Islam. 2002. "Paying for reproductive health services in Bangladesh: Intersections between cost, quality and culture". *Health Policy and Planning*, 17 (30): 273–80.
- Schultz, T.P. 2004. "Health economics and applications in developing countries". *Journal of Health Economics*, 23: 637–41.
- Seiber, E.E., D.R. Hotchkiss, J.J. Rous and A.A. Berruti. 2005. "Maternal and child health and family planning service utilisation in Guatemala: Implications for service integration". *Social Science and Medicine*, 61: 279–91.
- Stewart, J.J., G. Stecklov and A. Adewuyi. 1999. "Family planning program structure and performance in West Africa". *International Family Planning Perspectives*, 25 (Supplement): S22–S29.
- Tuoane, M., N.J. Madise and I. Diamond. 2004. "Provision of family planning services in Lesotho". *International Family Planning Perspectives*, 30 (2): 77–86.
- Ugaz, Cecilia. 2001. "The role of state in the provision of social services: Decentralisation and regulation". In Germano Mwabu, Cecilia Ugaz and Gordon White, eds., *Social Provision in Low Income Countries*. United Nations University. New York: Oxford University Press.
- WHO. 1999. "An assessment of reproductive health needs in Ethiopia sector priority". *Reproductive Health Matters*, 11 (21): 6–15.
- WHO. 2003. *Antenatal Care in Developing Countries: Promises, Achievements and Missed Opportunities. An Analysis of Trends, Levels and Differentials, 1990–2001*. New

York and Geneva: World Health Organisation (WHO). and United Nations Children's Fund (UNICEF).

WHO. 2006. Sexual and Reproductive Health – Laying the Foundation for a More Just World through Research and Action. Biennial Report 2004–2005. Geneva: World Health Organisation.

Appendix

Author/ Country	RH provision model features (providers, org. forms, management systems, delivery modes)	Evaluation question (links of provision model to performance, effectiveness, accessibility of services and efficiency)	Indicators (evaluation parameters)	Evaluation model	Empirical results (linking evaluation question to indicators)
Seiber <i>et al.</i> , 2005 (Guatemala)	Does not refer to any specific model, but tests whether integration is beneficial for FP uptake, by examining utilisation in both public and NGO run providers.	Assess whether the utilisation of modern MCH services influences subsequent contraceptive use, to provide a case for RH service integration. Assess the impact of the intensity of MCH service use, and its individual and community level determinants on subsequent contraceptive use in the highlands of Guatemala.	Contraceptive use: Numbers using methods Intensity of MCH service use: Index for the intensity of MCH care utilisation i.e. ante- and postnatal, delivery attendance and immunisations.	Full information maximum likelihood (FIML) regression techniques were used to model contraceptive use as a function of (1) the availability and quality of MCH and FP services (2) community and individual level determinants of health service and contraceptive use and (3) intensity of prior MCH service use. This model (FIML) controls for unobserved determinants of both MCH and FP service use.	Intensity of MCH service use is positively associated with subsequent contraceptive use, even after controlling for unobserved and observed individual, household and community level factors. This lends support to the proposition that the intensity of MCH service use does have a “causal” impact on subsequent contraceptive use.

Appendix continued

Routh and Khuda, 2000 (Bangladesh)	<i>Integrated:</i> Distribution of MCH and FP community-based (doorstep delivery of MCH-FP) and static clinics for clinical FP methods. <i>Provider:</i> Government (public) and NGO.	Examine the costs and effectiveness implications of the alternative strategies of delivering services from static clinics, community service points compared with doorstep strategy.	Programme costs for each strategy were estimated using the “ingredients” approach, i.e., allocating costs to cost centres based on time allocation and volume of production. Measures of effectiveness included FP and health measures, i.e., number of births averted using couple years of protection (CYPs) and QALYs gained in MCH services.	Economic evaluation/ appraisal using cost analysis and cost-utility analysis (quality-adjusted life years – QALYs).	Static clinic the most costly strategy, followed by doorstep and CSP. In terms of unit costs per MCH-FP output, the static clinic had the lowest per unit costs Provision of health and FP services from clinics - complemented with a reduced system of outreach workers in inform and target hard-to-reach clients- was found to be the most cost-effective service delivery alternative. Costs per birth averted and cost per QALY gained were lowest for the option of delivering services from static (fixed site clinics): US\$13 and US\$17 compared with corresponding values of US\$18 and US\$42 for the doorstep strategy. Overall comment was that in urban Dhaka, Bangladesh, a clinic-based service delivery strategy is a more cost-effective way of providing MCH-FP services than the costly doorstep distribution.
Stewart <i>et al.</i> , 1999 (West Africa: Côte d’Ivoire, Nigeria, Benin, Ghana and Guinea)	Public sector provision of FP services is integrated into the system of providing primary health care services-for all countries studied. Services are offered in conjunction with the local affiliates of IPPF. Each country has an NGO FP service structure that runs parallel to the public system and that is more or less vertical in structure. Most of the countries have social marketing or CBD programmes that utilise private market mechanisms to distribute contraceptive supplies. These programmes are largely vertical in their organisation.	Identify efficient organisational forms (vertical and integrated organisational structures) for service delivery given the scarcity of resources and growing RH needs.	Couple years of protection (CYP). Multiple measures of staff utilisation: • Staff utilisation rates; Family planning visit duration; • Family planning staff utilisation rate; • Total staff utilisation rates; • Exclusively family planning staff utilisation rate.	The model is descriptive and looks at the volume of service in terms of CYP and different kinds of staff utilisation rates. Case studies and large scale facility surveys in two of the five countries provide the data.	Facility surveys conducted in Côte d’Ivoire and Nigeria suggest that vertical FP service structures have staff capacity utilisation rates at or above 100 per cent and thus appear to use their labour resources more efficiently than do the integrated sites. Staff utilisation rates are somewhat higher in privately operated vertical programmes in Côte d’Ivoire than in government operated programmes in Nigeria. Vertical programmes also had somewhat higher staff utilisation rates even within government operated programmes. Where both vertical and integrated programmes exist, integrated programmes may not be necessarily superior.

Appendix continued

Jesus Amadeo <i>et al.</i> , 1991 (Colombia)	NGO Profamilia FP Programme, Vertical programme for FP Services, decentralised management, delivery both at the community and clinics.	How and where the programme might allocate resources to maximise the contraceptive protection it offers	Contraceptive protection (couple years of protection)	Maximisation of couple years of protection by providing protection at minimal costs by allocating resources between the community and facility based modes of service delivery.	The results show that the clinical subprogramme, which delivers mainly the IUCD, and the CBD programme, which delivers mainly the pill, are the most cost-effective. Per peso investment in these programmes yield most CYPs adjusted for cost-recovery and users' age. The voluntary sterilisation subprogramme is the least cost-effective because of the comparatively high costs of sterilisation, the high subsidy to clients who obtain this method, and the high mean age relative to the clients of other methods.
Charles Katende <i>et al.</i> , 2007 (Uganda)	An NGO vertical project in the districts with decentralised management. Services were provided both at facilities and through social marketing. The process was adjacent to government and private provision.	Impact of reproductive health efforts on contraceptive prevalence in the project area.	Association between geographical location, type of facility, range of contraceptives, dissemination of information and staffing with contraceptives use.	Statistical association between the health services delivery environment and contraceptive practice among the women in the project areas.	Through regression analysis the results show that no service delivery factor tested in the model showed any significance association in the rural areas. However, in the urban areas presence of private facilities and the existence of private sources of contraceptives were significantly associated with use.
Sohail Agha, 2002, (Sub-Saharan Africa – Cameroon, Botswana, Guinea and South Africa)	Vertical national social marketing programmes for RH commodities targeting adolescents in Cameroon, Botswana, Guinea and South Africa. Decentralised management of an intervention project funded by USAID.	Determine the performance of the intervention in reaching widely varying proportions of the target audiences, effecting positive changes in perceptions, beliefs and behaviour.	Indicators were derived from the Health Belief Model; changes between the baseline and post intervention in effectiveness of reaching the adolescents, perceptions about use and importance RH services and commodities and risky sexual behaviour.	Proxies of indicators identified from the Health Belief Model were entered in to a multivariate logistic regression to establish whether the changes had any statistical significance.	In Cameroon the intervention produced a net increase in perceived benefits protective behaviour and in self-efficacy among males and females, and a reduction in perceived barriers to protective behaviours among females. In Botswana women's perception of the level of risk involved in sexual activity and of the benefits of preventive measures increased. The intervention had few net positive effects among young women in Soweto, the site in South Africa. The intervention in Guinea had the least impact on health belief indicators.

Financing Reproductive Health Services in Africa: The Role of Aid, Insurance, User fees and General Taxation

Nana Enyimayew

Without appropriate financial resources, scaling up effective reproductive health interventions in order to achieve the Millennium Development Goal for maternal health (MDG 5)¹ will be virtually impossible. Yet little is known about how much is currently being invested in reproductive health services within African countries or whether levels of funding are changing. Estimates place the additional funding requirements to attain universal coverage at a minimum of US\$7 billion per year. Other estimates suggest that even greater investments are needed. Irrespective of the precise figure, the conclusion is clear: the financing gap represents a substantial sum in relation to domestic budgets.

Adequate, well-managed financing of public health systems in general continues to elude most countries. The difficulty is especially severe in low-income countries, most of which are in Africa, whose health systems struggle with meagre and inequitably distributed resources. Additionally, access to services for the most disadvantaged is usually very poor, further reducing the benefit of already scarce resources for those most in need. Success or otherwise of different health financing strategies is critical in determining the fate of such populations and therefore needs to be documented and presented to inform the development of right policies. Filling the information gaps requires appropriately designed and executed research.

At minimum, reproductive health (RH) services may be defined as those activities whose primary purpose is to restore, improve and maintain the health of women and their newborns during pregnancy, childbirth and the seven-day postnatal period. This chapter provides an update of the current knowledge of financing of RH services in Africa and suggests a framework for further research in these areas. It also presents examples of national and regional efforts to adopt and implement financing policies that aim to address national objectives of access, equity, quality and appropriate utilisation of RH services to meet MDG 5 by 2015. Issues of exemptions, subsidies and efficiency are also discussed within the scope of financing RH services. A review of basic services is presented in Table 5.1.

Table 5.1: Range of reproductive health services

Category of care	Interventions
Antenatal care	Basic antenatal care Management of severe anaemia Treatment of malaria Management of syphilis, gonorrhoea and Chlamydia
Normal delivery care	Clean and safe delivery Post-partum care Basic newborn care
Essential obstetric care	Management of eclampsia, sepsis, haemorrhage and abortion complications, plus provision of emergency caesarean section
Family planning	Family planning information and services
Other	Prevention and treatment of HIV/AIDS

How Much Do Reproductive Health Services Cost?

Information from various sources suggests that the per capita cost of providing a package of reproductive health services ranges between US\$0.5 and US\$6.0 (Weissman *et al.*, 1999; World Bank, 1993). Global costs for reproductive health are estimated at US\$7 billion dollars per year till 2015 while analyses done using the methodology of the UN Millennium Project suggest that family planning programmes in Africa alone would increase from US\$270 million in 2006 to nearly US\$500 million by 2015 (Cleland *et al.*, 2006). A selection of per capita cost estimates is presented in Table 5.2.

Table 5.2: Per capita cost estimates for reproductive health services

Service	Cost (US\$)
Mother and Baby package (1)	0.5 (current level of service provision)
Uganda 1999	1.4–1.8 (standard level of service)
WDR Global 1993 (2)	4.0
Making Motherhood Safe (3)	2.0–6.0
Range	0.5–6.0

Sources: (1) Weissman *et al.* (1999); (2) World Development Report (World Bank, 1993); (3) Ransom and Yinger (2002). Making Motherhood Safer.

The wide range of costs reflects the practical difficulty facing service providers, researchers, policy makers and society in general in meeting the requirements for accurate estimates of reproductive health care costs. These include defining the boundaries of RH, and standardising the content and quality of a given package of care.

Questions that continue to engage service providers and policy makers are; How much do reproductive health services at household, community and country level

cost? How much must governments and society spend on RH services to achieve national and global targets. What should be the minimum content of a standard package of care if countries in resource-constrained environments are to meet their targets?

Global estimates provide a useful guide to the broad picture, but it is more important that countries provide their own answers to these and related questions if they are to make meaningful investments in the health of women and children. The current trend in developing national and reproductive health accounts is one clear move in developing tools that will provide some important answers.

Financing Reproductive Health Services in Africa

Various modes and sources of payment are used to finance reproductive health services. Financing is an important issue because the mode of payment for services significantly influences access to and consumption of good quality health services by different subgroups in the population. A thorough understanding of the way in which different financing modes affect the health of women and children will equip policy makers, service providers and indeed society as a whole with knowledge and tools to adopt measures that will gain optimal health benefits from available resources.

The main modes of financing health care in Africa are general taxation, insurance, user fees and aid (Mwabu, 1990). According to the World Health Organisation (WHO), the world spent US\$3.6 trillion on health in 2004. Table 5.3 presents the distribution of global expenditure on health. Each mode of financing is briefly discussed below.

Table 5.3: Distribution of global expenditure on health by mode of financing

Financing mode or source	Percentage
Mother and Baby package (1)	0.5 (current level of service provision)
Government/General taxation (excluding social insurance)	34
Social insurance	25
Private insurance	19
Out-of pocket (user fees)	18
Others	4
All sources	100
Range	0.5–6.0

Source: www.who.int/nha/pie (2003)

General Taxation

Government funding to the health sector raised through taxation and accumulated in a national consolidated fund remains the most consistent source of funding, especially for salaries and running costs of the general health services. It is inadequate to meet the health needs of most African countries, however.

In 2000, 53 African heads of state, meeting in Abuja, Nigeria, pledged to allocate 15 per cent of their national budget to the health sector.² By 2003, only Liberia had reached this level of expenditure, while 19 countries reached between 10 per cent and 14 per cent.³ This suggests that the pledges have not been matched by political will. The scope to improve a country's performance in health and reproductive health services also depends on an improved economy. Empirical evidence suggests that as income improves, health indexes improve. Table 5.4 indicates the relationship between national income and selected health indexes. Regions with higher per capita income have lower mortality rates.

Table 5.4: Relationship between national income, maternal and infant mortality rates

WHO region	GNI	MMR	IMR
African Region (AFR)	2,074	910	100
South-East Asia Region (SEAR)	3,236	460	56
Eastern Mediterranean Region (EMR)	4,547	460	69
Western Pacific Region (WPR)	7,950	80	25
European Region (EUR)	17,819	39	18
Region of the Americas (AMR)	19,542	140	21

Notes: GNI = Gross national income per capita in US\$; IMR=Infant mortality rate (deaths per 1,000 live births); NNMR = Neonatal mortality rate (deaths per 1,000 live births); MMR = Maternal mortality ratio (deaths per 100,000 live births). Measures of reproductive (and child) health status are routinely used as key indicators of the health of a given population and have been revealed to have a close and inverse correlation to the economic and developmental status of a country.

Source: Data from WHO (2007).

Aid

A study tracking external aid to 150 developing countries estimated donor spending on activities related to maternal, newborn, and child health was estimated to be US\$1.99 billion in 2004, representing just 2 per cent of gross aid disbursements to developing countries (Powell-Jackson *et al.*, 2006). The 60 priority low-income countries that account for most child and newborn deaths received US\$1.363 billion, or 3.1 dollars per child. The Africa region accounted for over 45 per cent of Overseas Development Assistance (ODA), substantially more than other regions such as southeast Asia (20 per cent) and eastern Mediterranean (13 per cent). The region was also the largest recipient on a per child basis, receiving roughly \$8 per child.

The current level of ODA to maternal, newborn, and child health is inadequate to provide more than a small portion of the total resources needed to reach the MDGs for child and maternal health. If commitments are to be honoured, global aid flows will need to increase sharply during the next five years. The challenge will be to ensure that a sufficient share of these new funds is applied effectively towards scaling up key maternal, newborn and child health interventions in high priority countries.

A number of donors and international agencies have recently helped to ensure that there will be substantial increases in resources for selected health interventions in the next few years, which raises questions of how to sustain the increased expenditure thereafter.

User Fees

Another term used for this form of financing is *cost-sharing* because the patient pays part of the actual cost of service and the government pays for the rest. Unlike other forms of health care financing, such as pre-payment schemes or insurance, the timing of payment coincides with the need for health care; that is, user fees are charges that the individual pays for health care at the time of utilisation of the care. At public health facilities they are often set below cost-recovery levels.

Because they are charged at the point of use, these fees generate revenue instantly and are often an important source of funds for hospital services in African countries. In Sudan, user fees account for 81 per cent of total health care expenditure. In Nigeria and Côte d'Ivoire, 77 per cent and 75 per cent, respectively, of funds come from this source. In Ghana they provided 20–60 per cent of hospital recurrent expenditure in the 1990s, while in Tanzania, they constitute 30–60 per cent of the non-salary recurrent health expenditures.

Nevertheless, user fees are regressive and inequitable, in that poor people pay a greater proportion of their incomes out of pocket for health care than those who are better off. Furthermore, user fees can have a negative and sustained impact on the utilisation of health services especially in rural areas. Exemption policies aimed at protecting the poor from these negative effects have been difficult to implement largely because of lack of clarity on who is exempt, ambitious exemption coverage and lax supervision. (See Box 5.1 for an account of experiences from a selection of African countries.)

Health Insurance

Health insurance is a relatively new mode of financing in Africa. Experiences from other countries suggest that it will grow to become one of the most important modes of financing in tackling issues of access and equity to quality health services (see Box 5.2).

Box 5.1: Effect of user fees on utilisation of health services

Ghana: When user charges were officially introduced in Ghana in 1985 it was followed by a drop of up to 75 per cent in utilisation of health services in government facilities. The decrease in utilisation was greater and more sustained in rural facilities than in urban facilities but there was no evidence that women (and children) were more affected than the rest of the population. (Waddington and Enyimayew, 1989).

Kenya: In Kenya, the introduction of user fees (amounting to half a day's pay for a poor person) in government outpatient health facilities led to a reduction in the utilisation of services to treat sexually transmitted disease (STD) by both men and women (to 40 per cent and 65 per cent, respectively, of pre-fee rates). Nine months after their introduction, the fees were revoked, and women's utilisation rose to 22 per cent above the pre user fee levels (Moses *et al.*, 1992 and Mwabu *et al.*, 1995).

Other country experiences: Studies that look at specific women's health care services validate that they too are price sensitive and that utilisation has tended to drop when fees have been charged. Evidence from several African countries suggests that the use of maternal health care services is affected when fees are introduced or revoked. In Zimbabwe there was a decline in prenatal use in the early 1990s when user fees were strongly enforced. A study of the impact of user fees for antenatal care in government hospitals in three districts of Tanzania showed a 53.4 per cent decline in utilisation after fees were introduced. A study from Nigeria reports that when user fees were introduced, maternal deaths in the Zaria region rose by 56 per cent, while the number of deliveries in the main hospital declined by 46 per cent. In South Africa, antenatal care attendance improved after charges were revoked (Nanda, 2002).

Box 5.2: Types of insurance programmes

In its many forms, health insurance is a system for the advance financing of medical expenses through contributions or taxes paid into a common fund to pay for all or part of health services specified in a policy or law. The key elements are: advance payment of premiums or taxes, pooling of funds, and eligibility for benefits based on contributions or employment without an income or assets test. The basic categories of insurance are:

- **Public health insurance** (sometimes called *social health insurance*) is run by the government and may be compulsory for specific groups such as formal sector employees. An insurance scheme becomes a *National Health Insurance* when it covers the entire population, irrespective of whether a person has made a contribution or not. Burundi, Ghana, Kenya, Nigeria and Tanzania are examples of countries that have initiated social health insurance.
- **Private health insurance** is organised and administered by an insurance company or other private agency and membership is voluntary. Without adequate and regular incomes, most people in Africa, except the middle class, are unable to belong to this scheme. Women are at disadvantage. Under this scheme, childbirth is either not covered or the premium for the facility is higher. In a social context in which men are more likely to be within formal employment, they are more likely to be direct beneficiaries and women are more likely to be excluded.
- **Mutual health organisations** (MHOs) might be described as hybrid public/private schemes because they may be run by private organisations but subsidised by government.
- **Community-based pre-payment schemes** are run generally owned and by a community or a group of communities of relatively small populations. Instead of paying at the time of use of a health service, individuals and/or households make payment in advance and are then able to use services free of charge when needed. Most rural pre-paid community scheme receive contributions during harvest time when there is the ability to pay scheme contributions, as in Tanzania.

Mutual health organisations (MHO) in developing countries are increasingly recognised as a promising domestic financing strategy in low-income countries (Commission on Macroeconomics and Health, 2001). They have the potential to cover basic health care costs for members while avoiding the financial strain that is often associated with unexpected medical care. Lessons learnt from the initial MHOs (largely operated by faith-based organisation) during a decade of experimentation enabled Ghana's national health insurance scheme to achieve a relative degree of success (see Box 5.3). Within two years of passing the National Health Insurance Act, 123 of 136 districts in the country had initiated the process of implementation and 65 (53 per cent) of these were either paying out benefits and claims to providers or were ready to do so. Coverage of the national population reached 18 per cent⁴ in 2006 and was targeted to reach 50 per cent by 2007.

Box 5.3: National health insurance and management of mutual health organisations in Ghana

Within the context of its Poverty Reduction Strategy (2003), the Ghana government implemented a national health insurance scheme in an effort to provide accessible, affordable, good quality health care to all Ghanaians. The National Health Insurance Act (NHIA 2004) mandates all districts to establish mutual health organisations funded by sales tax (2.5 per cent), formal sector worker contributions (2.5 per cent of gross salary), and voluntary payments by informal sector workers (US\$7.5 minimum). The government has defined a minimum benefit package of interventions (which includes free antenatal and delivery services) that every MHO must cover and has listed premium levels. Further standardisation relates to family registration, probation periods and tariffs (NHI Regulations 2004). Ghana is one of the first African countries aiming to implement MHO nationwide.

MHOs emerged in Ghana in the mid-90s. A survey of 45 private and public MHO in 2004–2005 found that private ones had more autonomy in setting premiums and benefits packages and high community participation in meetings than public ones. MHOs in general had few measures in place to control moral hazard and reduce adverse selection, but had more measures to control fraud and prevent cost escalation. Formally trained and paid staff managed the vast majority of schemes. (The members of an MHO constitute a Board to which staff are expected to be accountable. Little of this happens in practice.)

The success of MHOs has been said to depend on various dimensions including the political will to establish schemes, the purchasing power of the community and the (perceived) quality of care. In addition, success stems from two dimensions that are related to the MHO themselves: First, the success of an MHO depends on building trust in the community to attract and keep clients, and is strongly related to its organisational structure, e.g., community participation, local ownership and autonomy in decision making. Second, the capability to manage an MHO remains one of the biggest challenges facing these organisations in Ghana. Most schemes to date have been relatively small in terms of the number of members and lack adequate financial management. (Source: Baltussen *et al.*, 2006:654–9).

An independent review of the country's national health insurance scheme noted a number of challenges to be met before the district level schemes, in particular, will reach their potential. These include: building financial analysis and business planning skills; improving claims management procedures and software; developing a patient information management system; instituting accreditation and

quality assurance procedures; and strengthening purchasing skills in general, in relation to providers. Other needs are stronger community links, including through better use of the health insurance boards; improved registration procedures; a communication strategy for marketing, channeling complaints and reducing frivolous use of the health insurance scheme; and prescriber training in rational prescribing (Ministry of Health, Ghana, 2007).

Addressing Waste and Inefficiency in Health Service Delivery

Even in the resource-constrained environment of Africa, there is scope for increasing resources available for service delivery especially by minimising wasteful spending. Many anecdotal accounts point to waste and inefficiency in resource use, particularly in public sector services. In the context of this discussion on financing reproductive health services it is pertinent to highlight the extent of the problem and the potential for increasing resources for health service delivery through waste containment measures. Hard data are difficult to come by because much of the waste is associated with corrupt practices (such as in the procurement of goods and services) and consequently there are deliberate efforts to withhold information.

In 1981, Management Sciences for Health (MSH) estimated that of every US\$1 million spent on purchasing drugs, only US\$300,000 (30 per cent) resulted in therapeutic benefit; 70 per cent was lost through spoilage, theft and leakages, poor prescription habits, and unfair pricing. Anecdotal accounts have it that an inventory of drugs in MOH medical stores in Ghana in the early 1990s revealed that 50 per cent (worth about half of the annual drug bill at that time) was expired or due to expire within six months.⁵ In a particular instance, the stocks of a slow moving drug were enough to meet the national needs for decades. Similar accounts suggest that such wastage is replicated in many countries today. Other resources – staff time, official vehicles, medical and office equipment and funds – are all misappropriated, resulting in significant loss of resources to the service.

Improved management and better governance, backed by appropriate legislation, incentives and enforcement measures hold promise for re-directing these resources back to public institutions. The enactment and strict enforcement of procurement laws and the upgrading of staff skills in national and international procurement have demonstrated the potential for improvement in some African countries.

Influencing Policy with Research

The focus of research in reproductive health should specifically be to initiate strategic advocacy and policy responses to facilitate a rights-based approach to sexual and reproductive health (SRH) service provision and health status overall on the continent. A number of key questions need to be addressed in such research:

- Who are the key role players that need to be targeted to develop an understanding of the importance of integrating SRH service provision with financing reforms in ways that have positive health outcomes? What are their perspectives?
- How do barriers to reproductive health services differ for key target groups – adults and adolescents? How can these be addressed? How can women cope with user and other out-of-pocket fees in relation to different health needs and services? What are the budgetary implications of user fees at the household level? What are the health consequences of delays in health care seeking or recourse to affordable but ineffectual care? What trade-offs do women make in order to pay for health care?
- What are the financial and human development benefits of investing in SRH services in Africa? What are the specific financing-related challenges experienced by countries in Africa in expanding SRH services in line with ICPD specifications? How can these be addressed?
- What new roles can/should donors play in financing RH services if the global targets are to be met?
- How much does each funding source provide for RH services? What have been the trends and what are future projections likely to be in the light of changing aid and financing environment (General budget support; Paris Declaration on Aid Harmonisation; One-UN Initiative; National Health Insurance schemes). What effect has each funding modality on access, equity and quality? What incremental funding is needed to attain optimal RH care and thereby improve the impact of RH services?

Among some of the specific approaches to finding answers to these questions are the following:

- **User fees:** If user fees and other out-of-pocket costs are retained in resource poor settings, then there is a need for research to demonstrate whether and how such fees can be successfully and equitably implemented. Research is needed to demonstrate how user fees can improve the resources available in primary health care settings without reducing utilisation or hurting those who are poor and vulnerable.
- **Equity:** Research is needed to identify the barriers to equity in relation to SRH and other health service delivery. This should include the scope for redistributing available resources to achieve more and better RH outcomes, and determining where governments can shift money without sacrificing the gains already made. It should also investigate the conditions necessary for ensuring equitable implementation of user fees and other out of pocket costs.

- **Gender-specific issues:** There is need for gender-disaggregated data in relation to health services generally and to reproductive health services in particular. This means taking into account not only user fees and other out-of-pocket fees charged by public health providers, but those of private and traditional providers as well. Issues around women's ability to pay are pertinent to thinking about other methods of cost-recovery, including pre-payment schemes and health insurance mechanisms.
- **Tracking progress:** There should be better monitoring of progress made in improving maternal health, with an expanded set of indicators and targeted research on intrapartum care based in health centres. This requires an improvement in data quality, the creation of a monitoring and evaluation of maternal outcomes group, and a statement on data quality as it relates to maternal health (Filippi *et al.*, 2006).

Conclusion

The mode of financing a health system is a key determinant of a population's health and wellbeing. In many of the poorest countries, the level of spending is still insufficient to ensure equitable access to basic and essential health services and interventions, and therefore a major policy issue is how to ensure adequate and equitable resource mobilisation for health.

Government funding is the most sustainable source of health care financing in many African countries. Sound economic policies backed by government commitment to their implementation can lead to real increases in government spending in reproductive health services. Although donor aid is generally regarded as part of the national development effort, it can be unpredictable. It does have a place in targeting programmes like reproductive health, however, that are high on donor agendas.

User fees should not stand alone; they are retrogressive and hurt the poor disproportionately. Insurance addresses the shortcomings of the user fees and holds promise as a sustainable source of financing, but needs a long-term framework for introduction and extension to cover a significant proportion of the population. There is an urgent need to document the African experience in various health financing approaches in reproductive health and to share lessons learnt in order to achieve the best mix of financing to accelerate the continent's progress toward achieving the Millennium Development Goals.

Notes

1. MDG 5, Improve maternal health, has its target to reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio.

2. This pledge, the so-called Abuja Declaration, was re-affirmed in the Gaborone Declaration during the October 2005 session of the Conference of African Ministers in Botswana.
3. In Liberia, post-war reconstruction aid included a significant component of provision of basic health services. Where external resources continue to fund a large part of the health sector and with no assurances of aid predictability over the long term, sustainability is a major concern.
4. This refers to those who have registered and are eligible to enjoy the benefit package.
5. Finding from an exercise carried out by MOH and presented to the national drug quantification committee, of which the author was a member.

References

- Baltussen, R., E. Bruce, G. Rhodes, S.A. Narh-Bana and I. Agyepong. 2006. "Management of mutual health organisations in Ghana". *Tropical Medicine and International Health*, 11 (5, May): 654–9.
- Cleland, J., S. Bernstein, A. Ezeh, A. Faundes, A. Glasier and J. Innis. 2006. "Family planning: The unfinished agenda". *The Lancet*, 368 (9549, 18 Nov): 1810–27.
- Commission on Macroeconomics and Health. 2001.
- London School of Hygiene & Tropical Medicine, London, WC1 3DP. John.Cleland@lshtm.ac.uk PMID: 17113431 [PubMed - indexed for MEDLINE].
- Filippi, V., C. Ronsmans, O.M. Campbell, W.J. Graham, A. Mills, J. Borghi, M. Koblinsky and D. Osrin. 2006. "Maternal health in poor countries: The broader context and a call for action". *The Lancet*, 368 (9546, 28 Oct): 1535–41. PMID: 17071287 [PubMed - indexed for MEDLINE].
- Ministry of Health. 2007. *Health Sector 5-year Programme of Work 2002-2006*. Independent Review report. Government of Ghana, June.
- Moses, S., F. Manji, J.E. Bradley, N.J. Nagelkerke, M.A. Malisa and F.A. Plummer. 1992. "Impact of user fees on attendance at a referral centre for sexually transmitted diseases in Kenya". *The Lancet*, 340 (8817, 22 Aug): 463–6. POPLINE Document Number: 075107.
- Mwabu, G. (1990). "Financing Health Services in Africa: An Assessment of Alternative Approaches", World Bank, WPS 457, Washington D.C.
- Mwabu, G., J. Mwanzia and W. Limbila (1995). "User Charges in Government Health Facilities in Kenya: Effect on Attendance and Revenue, *Health Policy and Planning*, 10 (2):164–70.
- Nanda, P. 2002. "Gender dimensions of user fees: Implications for women's utilisation of health care". *Reprod Health Matters*, 10 (20, Nov): 127–34. Center for Health and Gender Equity, Takoma Park, MD, USA. pnanda@genderhealth.org PMID: 12557649 [PubMed - indexed for MEDLINE].
- Powell-Jackson, T., J. Borghi, D.H. Mueller, E. Patouillard and A. Mills. 2006. "Countdown to 2015: Tracking donor assistance to maternal, newborn, and child health". *The Lancet*, 368 (9541, 23 Sep): 1077–87.

- Health Economics and Financing Programme, London School of Hygiene and Tropical Medicine, London, UK. timothy.powell-jackson@lshtm.ac.uk PMID: 16997662 [PubMed - indexed for MEDLINE].
- Ransom E.I. and N.V. Yinger. 2002. *Making Motherhood Safer: Overcoming Obstacles in the Pathway to Care*. MEASURE Communication. Washington, D.C.: Population Reference Bureau.
- Waddington, C. and N. Enyimayew. 1989. "A price to pay: The impact of user charges in Ashanti Akin District of Ghana". *Int'l J of H. Planning and Management*, 4: 17.4.
- Weissman, E., O. Sentumbwe-Mugisa, O.K. Mbonye and C. Lissner. 1999. "Costing safe motherhood in Uganda". In Marge Berer and TK Sundari Ravindran, eds., *Safe Motherhood Initiatives: Critical Issues*, pp. 85–92. Oxford: Blackwell Science.
- World Bank. 1993. *World Development Report: Investing in Health*. New York: Oxford University Press.
- WHO. 2007. *World Health Statistics 2007*. World Health Organisation, Geneva.

Futher Reading

- Crane, B.B. and J. Dusenberry. 2004. "Power and politics in international funding for reproductive health: The US Global Gag Rule". *Reprod Health Matters*, 12 (24, Nov): 128–37.
- Ipas, Chapel Hill, NC, USA. craneb@ipas.org PMID: 15626203 [PubMed - indexed for MEDLINE].
- Gilson, L. 1997. "The lessons of user fee experience in Africa". *Health Policy Plan*, 12 (4, Dec): 273–85. University of Witwatersrand, South Africa. PMID: 10176263 [PubMed - indexed for MEDLINE].
- Gilson, L. and A. Mills. 1995. "Health sector reforms in sub-Saharan Africa: Lessons of the last 10 years". *Health Policy*, 32 (1–3, Apr–Jun): 215–43. Health Policy Unit, London School of Hygiene and Tropical Medicine, UK. PMID: 10156640 [PubMed - indexed for MEDLINE].
- Hotchkiss, D.R., K. Krasovec, M.D. El-Idrissi, E. Eckert and A.M. Karim. 2005. "The role of user charges and structural attributes of quality on the use of maternal health services in Morocco". *Int J Health Plann Manage*, 20 (2, Apr–Jun): 113–35. Tulane University, School of Public Health and Tropical Medicine, New Orleans, Louisiana, USA. david.hotchkiss@tulane.edu.
- Howard, L.M. 1991. "Public and private donor financing for health in developing countries". *Infect Dis Clin North Am*, 5 (2, Jun): 221–34. Office of Health, US Agency for International Development, Washington, D.C. PMID: 1869807 [PubMed - indexed for MEDLINE].
- James, C.D., K. Hanson, B. McPake, D. Balabanova, D. Gwatkin, I. Hopwood, C. Kirunga, R. Knippenberg, B. Meessen, S.S. Morris, A. Preker, Y. Souteyrand, A. Tibouti, P. Villeneuve and K. Xu. 2006. "To retain or remove user fees?: Reflections on the current debate in low- and middle-income countries". *Appl Health Econ Health*

- Policy, 5 (3): 137–53. London School of Hygiene and Tropical Medicine, London, UK. PMID: 17132029 [PubMed – in process].
- Korte, R., H. Richter, F. Merkle and H. Gorgen. 1992. “Financing health services in Sub-Saharan Africa: Options for decision makers during adjustment.” *Soc Sci Med*, 34 (1, Jan): 1–9.
- Department of Health, Population and Nutrition, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, Eschborn, Fed. Rep. Germany. PMID: 1738850 [PubMed - indexed for MEDLINE].
- Leighton, C. 1995. “Overview: Health financing reforms in Africa”. *Health Policy Plan*, 10 (3, Sep): 213–22. Abt Associates Inc., Bethesda, MD 20814, USA. PMID: 10151840 [PubMed - indexed for MEDLINE].
- Mayhew, S.H., G. Walt, L. Lush and J. Cleland. 2005. “Donor agencies’ involvement in reproductive health: Saying one thing and doing another?” *Int J Health Serv*, 35 (3): 579–601.
- Center for Population Studies, London School of Hygiene and Tropical Medicine, London, England susannah.mayhew@lshtm.ac.uk PMID: 16119577 [PubMed - indexed for MEDLINE].
- Palmer, N., D.H. Mueller, L. Gilson, A. Mills and A. Haines. 2004. “Health financing to promote access in low income settings – How much do we know?” *The Lancet*, 364 (9442, 9 Oct 9-1515 Oct):1365–70. Comment in: *The Lancet*, 365 (9459, 12–18 Feb): 569–70; author reply 570.
- London School of Hygiene and Tropical Medicine, London, UK. natasha.palmer@lshtm.ac.uk PMID: 15474141 [PubMed - indexed for MEDLINE].
- Peters, D.H., A.E. Elmendorf, K. Kandola and G. Chellaraj. 2000. “Benchmarks for health expenditures, services and outcomes in Africa during the 1990s”. *Bull World Health Organ*, 78 (6): 761–9. The World Bank, Washington, DC, 20433, USA. dpeters1@worldbank.org PMID: 10916913 [PubMed - indexed for MEDLINE].
- Sekwat, A.J. 2003. “Health financing reform in sub-Saharan Africa: Major constraints, goals, and strategies”. *Health Care Finance*, 29 (3, Spring): 67–78. Institute of Government, Tennessee State University, USA. PMID: 12635996 [PubMed - indexed for MEDLINE].
- Robey, B. and U. Upadhyay. 1999. “Speeding the reproductive revolution”. *People Planet*, 8 (1): 18–9. PMID: 12322000 [PubMed - indexed for MEDLINE].
- Russell, S. and L. Gilson. 1997. “User fee policies to promote health service access for the poor: A wolf in sheep’s clothing?” *Int J Health Serv*, 27 (2): 359–79. PMID: 9142607 [PubMed - indexed for MEDLINE].
- Willis, C.Y. and C. Leighton. 1995. “Protecting the poor under cost recovery: The role of means testing”. *Health Policy Plan*. 10 (3, Sep): 241–56. Abt Associates, Inc., Bethesda, Maryland 20814, USA. PMID: 10151842 [PubMed - indexed for MEDLINE].

Conceptual and Methodological Issues in the Construction of Reproductive Health Accounts in Africa

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A number of global initiatives have brought the issues of reproductive health (RH) to the front banner of international attention and discourse in the last decade or so. The International Conference on Population and Development (ICPD) held in Cairo in 1994, for example, pushed the issue of reproductive health onto the agenda of global health priorities. Globally and in many countries, problems related to pregnancy and delivery, as well as sexually transmitted diseases, sexual rights and the practices of various subgroups within a population have always been of concern because of the large amount of related mortality, morbidity and suffering. Thus, poor reproductive health accounts for 36 per cent of women's total disease burden (Murray and Lopez, 1996).

There are, besides, an estimated 76 million unwanted pregnancies in developing countries per year, of which 19 million ends in unsafe abortion causing the death of 68,000 women. The estimated number of persons living with HIV worldwide in 2007 was 33.2 million (30.6 million–36.1 million). Every day, over 6,800 persons become infected with HIV and over 5,700 persons die from AIDS, mostly because of inadequate access to HIV prevention and treatment services (UNAIDS, 2007). All these confirm the high global burden of reproductive health problems.

The Problem

The Millennium Development Goals (MDGs), provide a target for the reduction of maternal mortality by 75 per cent by 2015, this has prompted countries to set ambitious plans for enhancing RH services such as expanding services, improving service quality and adapting services to meet user needs more appropriately. As expected, such ambitious plans require additional resources. However, in spite of these ambitious initiatives and their daunting resource requirements, policy makers in most middle- and low-income countries and in particular, Africa, lack critical information about current national spending on RH care. Among the issues where critical information is lacking are: how much is spent, the sources of financing, the patterns of resource flows and how the expenditures link to RH outcomes. This lack

* We acknowledge the excellent research assistance of Akanni O. Lawanson and Felix Adekunjo.

of information limits the ability of policy makers to develop appropriate, sustainable policies that will lead their countries to achieve relevant MDG targets.

A better understanding of the ways in which health services are financed is a major contributor to understanding why the available resources are not translated into better health outcomes and the identification of measures that can improve this situation. Concern about health financing goes beyond the issue of raising funds, however; it includes issues of fund allocation as well as the behaviour of providers and consumers. It considers such key issues as: what is the total spending on health, who is spending it and what is it being spent on. Further, it must address issues of what are the sources of this expenditure, and how does it compare to spending in other countries in the region. The main trends and the efficiency of the allocation of funds and recommendations for the improvement of health services is another issue. Indeed, one can raise issues about increasing the level of resources available and using and allocating existing resources more efficiently? So that public subsidies can effectively target poor and vulnerable groups (DFID 2000).

The Health Accounts (HA) framework can provide answers to these questions and/or give insights into how these concerns can be addressed. This chapter seeks to apply the HA framework to address issues relating to the financing of RH in Africa with a view to improving RH outcomes, in the final analysis.

The chapter is organised in six sections. In Section 2 we discuss the conceptual and definitional issues in health accounts as well as reproductive health. A review of relevant literature in HA estimation and costing of RH is presented in Section 3. Section 4 analyses some important consideration in Reproductive Health Accounts (RHA) estimation, while Section 5 describes the suggested framework for RHA estimation in Africa. In this section we also provide an illustrative and indicative empirical example of the estimation and interpretation of HA in an African country. We draw some conclusions in Section 6. The chapter adopts a utilitarian approach, providing as much relevant information place as practicable. We have also incorporated several annexes deemed useful in RHA estimation in Africa.

Conceptual and Definitional Issues in Health Accounts and Reproductive Health

Resource tracking is a necessary part of health system development. The financial information about who pays, how much and for what that is generated by the source tracking is most effectively organised in the National Health Accounts (NHA) framework. The NHA framework captures a country's *total* health expenditure by all stakeholders in the health sector over a period, usually one year. It is based on a feasible and useful definition of the boundaries of the healthcare sector and it analyses health expenditures based on a flow of funds framework linking various actors and stakeholders (Berman, 1997).

Health Accounts Concepts

Health expenditure¹ is defined by *purpose*. It consists of all spending on activities whose *primary purpose* is to *restore, improve and maintain* the health of the nation and individuals (WHO, 2003). This definition applies regardless of the type of institution or entity providing or paying for the health activity. For example, prior to the use of NHA, spending by the Ministry of Education (MOE) on medical training and teaching hospitals was excluded from health expenditure estimates. Similarly, under the NHA definition, not all activities conducted by the Ministry of Health fit within the health expenditure definition. For example, where a Ministry of Health (MOH) funds the operation of orphanages *without* the primary purpose of restoring, improving and maintaining health, then this is deemed as a non-health expenditure.²

The NHA framework first identifies the different *actors* (or stakeholders) in the health system, their relevant *activities*, and the financial *transactions* between the actors in carrying out their designated activities. The classification of actors, activities and transactions in meaningful categories that share common characteristics is at the heart of the HA methodology. The stakeholders involved in health financing *mobilise, allocate and utilise* funds. Entities mobilising and providing health funds are called *financing sources*, while those channelling the funds to pay for or purchase the activities in the NHA boundary are known as *financing agents*. Those receiving money in exchange for or in anticipation of producing the activities in the NHA boundary are called *providers or uses*.

Financing sources include government (at all levels), households, firms and donor agencies (domestic and foreign). *Financing agents* include Ministry of Health (and equivalents at lower levels of government); other ministries and agencies that have significant health expenditure (e.g., defence, police, women affairs, prisons, etc.); health insurance companies; out-of pocket expenditure of households; non-government organisations; and health units of firms. *Providers or uses* include public and private health facilities, chemists/pharmacies, traditional care providers, health research/training institutions, and administration/management of health care.

NHA estimates are usually presented in a matrix (tabular) format indicating the flow of funds between stakeholders. Examples of NHA matrixes are: sources by financing agents; financing agents by providers; financing agents by functions; financing agents by location; and providers by functions.

The NHA framework allows for further stratification of funding flows by disease-specific areas (malaria or HIV/AIDS, for example) and intervention clusters (reproductive health, child health, etc.). These stratifications involve additional expenditure reviews referred to as NHA *sub-analyses*. Such sub-analyses, particularly when done on a routine basis, and in part because of their specific policy themes, moves one step closer to linking spending patterns to actual results. The Reproductive Health Account (RHA) is a sub-account or satellite account of the NHA. In the RHA, actors, activities and transactions are limited to those that are involved in reproductive health. The approach of situating the RHA within the

context of an NHA places a country's spending on reproductive health within the context of overall health spending.

Boundary issues in health accounts

In measuring national health expenditures, NHA does not use the geographical borders of a country but rather looks at the health transactions of that country's citizens and residents. It thus includes expenditure on health care by citizens and residents who are temporarily abroad and excludes spending on health care by foreign nationals within the country. Spending by international organisations on health and health-related goods and services for the residents of the recipient country are also considered national health expenditure.

An NHA usually covers a period of one year. However, the "accrual" method is used to define the time the expenditure is *recognised*. That is, expenditures are recorded for the time period in which the activity takes place and not when the actual payment is made. For example, if a hospital stay occurs during the final month of fiscal year 2002 but payment is made in fiscal year 2003, the expenditure is recorded for fiscal year 2002.

Dimensions of NHA

PHR*Plus* (2002) asserts that one or more of the following characteristics make the NHA very distinct from other expenditure reviews: a rigorous classification of the types and purposes of all expenditures and of all the actors in the health system; a complete accounting of all spending for health, regardless of the origin, destination or object of the expenditure; a rigorous approach to collecting, cataloguing and estimating all those flows of money related to health expenditure; and a structure intended for ongoing analysis (as opposed to a one-time study).

When constructed properly, a nation's HA complements other reporting systems to provide a more complete picture of the performance of the health system. Because of the similarity between measurement concepts underlying the NHA and the system of national accounts used to estimate a country's gross domestic product (GDP), health accounts can be used to illuminate the interrelationship between health spending and the total output of the economy. Because of the way in which financing is displayed, health accounts can help in understanding the roles of government, industry, households and external organisations (such as the Red Cross and Red Crescent) in the purchase of health care. Because of their reliance on standardised classifications of providers and functions, the NHA illustrates the linkages between financing and delivery and outcomes of health services and goods. Two important dimensions of the NHA in the health system policy are its use as a link between the various subsectors of the health system including as a barometer of health system assessment, and the input it provides for evaluating the stewardship role of government in the health system.

NHA in the context of health systems and health system performance measurement

All nations have health systems, which have been described as, all the activities whose primary purpose is to promote, restore or maintain health, (Pass *et al.*, 1991). Whether arrived at by conscious creation or by evolution, health systems exist to produce some benefit for societies and their citizens. A health system mobilises and channels resources into institutions and uses them for individual or social consumption. This consumption of goods and services produces a flow of benefits to the population, which results in a new level of health.

The performance of a health system reflects a number of facets of its operation: there is the effect of the system on the health of the population; and, there is the extent to which financing and risk pooling mechanisms afford financial protection from the economic burden of illness and prevent impoverishment resulting from catastrophic expenses for health care. There are other dimensions as well, for example the responsiveness of health systems to the people they serve in aspects such as respect of personal dignity and privacy. Health system performance must be assessed not only in terms of the level of benefits achieved but also by their distribution in societies. If a nation's health system can be thought of as a society's response to its citizens' desire to achieve certain benefits or outcomes and to distribute these benefits fairly, health system performance refers to how well the system achieves those goals. The NHA framework enhances all these goals.

National health accounts as an input to stewardship for improving health system performance

Governments and others can use HA in several ways. In addition to a picture of the financial state of the health system, HA can provide information relevant to designing better health system policies. Experience in the countries that have developed and used HA has been that the accounts are very helpful in answering questions such as those discussed briefly following (WHO, 2003).

How are resources mobilised and managed for the health system?

Health accounts help to provide the basis for assessing the adequacy of financial resources available to the health system and for thinking about strategies to increase the resources available. They indicate the types of social structures in the public and private sectors that have been created to raise, organise and pool funds, and to pay for the production of goods and services.

Who pays and how much is paid for health care?

Knowledge about who finances health care and how large their financial burden is relative to their means illuminates the nature of financial protection and the fairness of the financial burden. Knowing who contributes to health spending is also important for designing policies and interventions. For example, many countries are decentralising their public finances and relying more on provincial and municipal funding for social services. Health accounts can reveal not only how well but also

how fairly those arrangements pool risks across the population. They can also clarify how institutions that pay for or purchase health care compensate providers and with what effect.

Who provides goods and services, and what resources do they use?

The answers to these questions describe the allocation of expenditure to different types of providers and to the production factors used in the system. These are dimensions of economic planning and of the analysis of economic efficiency, both of which are important focuses of decision making.

How are health care funds distributed across the different services, interventions and activities that the health system produces?

Health accounts indicate what is produced and what is spent on the different products. The commitment of resources to health functions is a valuable measure of the actual priorities of a health system. Such information indicates whether an allocation always reflects actual priorities. For example, health accounts reveal the share of spending claimed by collective public health interventions, reproductive health or cardiovascular conditions. Measures like these are also excellent indicators of whether policies to shift resource priorities are working.

Who benefits from health care expenditure?

This question can be answered along a variety of different dimensions, including income groups, age/gender groups, geographical regions, health status or conditions, or types of interventions provided. Knowing where the benefits from health expenditure go in terms of their financial value is an important measure in the assessment of distributional fairness (WHO 2003).

Reproductive Health Concepts

Adapting the WHO definition of health, ICPD (1994) defined RH as, a state of complete physical, mental and social wellbeing, and not merely the absence of disease or infirmity, in all matters relating to the reproductive system and to its processes and functions. Reproductive health therefore implies that people are able to have a responsible, satisfying and safe sex life and that they have the capability to reproduce and the freedom to decide if, when and how often to do so. Implicit in this are the rights of men and women to be informed of, and have access to, safe, effective, affordable and acceptable methods of fertility regulation of their choice, and the right of access to appropriate health care services that will enable women to go safely through pregnancy and childbirth and provide couples with the best chance of having a healthy infant.

The reproductive health portion of the ICPD Programme of Action calls for all nations: To ensure that comprehensive and factual information and a full range of reproductive health-care services, including family planning, are accessible, affordable, acceptable and convenient to all users (through the primary health care system by 2015); to enable and support responsible voluntary decisions about

childbearing and methods of family planning of their choice, as well as other methods of their choice for regulation of fertility that are not against the law and to have the information, education and means to do so; and, to meet changing reproductive health needs over the life cycle and to do so in ways sensitive to the diversity of circumstances of local communities (http://www.unfpa.org/monitoring/pdf/n2_issue22.pdf).

According to the WHO (1995a) reproductive health has three main priority areas: family planning (information, counselling and services); prevention of maternal and newborn deaths and disabilities by providing adequate maternal and child health services, preventing unwanted pregnancy and unsafe abortion; and, prevention and management of sexually transmitted diseases and infections of the reproductive tract, including prevention and management of the acquired immunodeficiency syndrome (AIDS).

Other dimensions of the reproductive health package are: prevention and management of infertility; issues of violence against women including harmful traditional practices as female genital mutilation and forced early marriages; and meeting the specific reproductive health needs of target groups other than women in their reproductive ages: adolescents, men and women beyond the reproductive age.

Expanding access to these services and improving the quality of care are essential components of the process leading to better reproductive health. All related services should directly respond to people's needs and therefore be planned and implemented in collaboration with the concerned community. Integration of these services into general primary health care services should allow easier access and more efficient management of scarce resources.

Sexual and reproductive health service issues

The users of sexual and reproductive health (SRH) services overwhelmingly are women. This has been significant in framing the societal and state response to the financing and provision of SRH services. Within the context of patriarchal societies, the fact that SRH services have largely targeted and serviced women has served to undermine the value of the service. Moreover, because they have traditionally been located within a "population control paradigm", the emphasis has been on controlling women's fertility rather than on encouraging women to take control of their reproduction and sexuality. In order to meet the rights-based requirements espoused by ICPD, services have to be rendered in ways that enable women to make healthy choices.

In addition, the actual services to be provided are considerably broader than those under the historical reproductive health paradigm of family planning, limited prenatal care and essential obstetric care. The elements of the SRH service package envisaged by ICPD include a wider range of services: family planning based on choice; safe pregnancy and childbirth; the prevention, diagnosis and treatment of reproductive tract infections (RTIs), sexually transmitted infections (STIs) and the

human immunodeficiency virus (HIV); and the elimination of harmful practices such as female genital mutilation (FGM) and domestic violence. This expanded package also includes services such as treatment of HIV-positive pregnant women to prevent transmission of HIV to the foetus and newborn, infertility management, and the detection and treatment of reproductive cancers.

Health systems have a long way to go in providing comprehensive, integrated SRH services that are rights-based and meet the myriad challenges facing African populations. In addition to the increased scope of service provision required, there are growing demands on the health system relating to the HIV/AIDS pandemic, as the client base is expanding to include men, adolescents, and HIV-positive women, men and infants. These factors translate into increased resource requirements to ensure that the paradigm shift for SRH services can be realised.

Maternal and child health/RH: any difference or inter-relation?

To a certain degree there may be confusion about how the older term of MCH (maternal and child health) and the newer concept of reproductive health interrelate. The two concepts overlap to a large extent, mainly on the side of “safe motherhood”.

Specifically for child health, a cut off seems to be made at the age up to which the care provided to the infant has an influence on the mother’s reproductive health and vice versa. Questions concerning breastfeeding and postnatal HIV transmission from mother to child, for example, would therefore be considered an RH issue while EPI vaccination programmes for children under five would not. But there seems to be no clear-cut definition or consensus on this point, resulting in every agency having a slightly different policy.

Review of Relevant Literature

International comparative studies of health expenditure have been conducted for more than 30 years. The UN methodology for National Accounts (NA) – approaching health expenditure through a subsets or satellite accounts of NA – was not answering some of the important questions for the health sector. The International Labour Organisation (ILO) and WHO in the 1950s and 1960s led the movement to create standardised, comparable national health expenditure estimates (Abel-Smith, 1963).

Evolution of NHA

Recognising the important role of health care financing in comparative health system analysis, the Organisation for Economic Cooperation and Development (OECD) has systematically developed and applied a common format, called the System of Health Accounts (SHA), for reporting national health expenditures. Today, the OECD annually compiles comparable health expenditure statistics for its member countries; for most countries data covers over 30 years (OECD, 1998).

In 1964, the United States adopted the NHA approach, which mainly added to the SHA method a more disaggregated “sources and uses” matrix. Because of its comprehensiveness and high level of detail, the NHA approach is considered by many to be the gold standard for estimating health expenditures, particularly in countries with highly pluralistic health financing structures. The current NHA approach, which is a confluence of the approaches mentioned above, depicts source and destination of financial flows.

NHA Classification Scheme and Other Methodological Issues

To understand the myriad transactions taking place in a nation’s health system, health accountants make use of classification schemes that allow them to roll up or summarise economic activities in a meaningful way.³ These classification schemes group transactions that share common characteristics in one or more dimensions that satisfy defined criteria. A good classification scheme should: represent an important, policy relevant dimension and partition the dimension in policy relevant ways; partition the dimension in a mutually exclusive and collectively exhaustive way, so that each transaction of interest can be placed in one – and only one – category; respect and reflect, to the extent possible, existing international standards and conventions; and be feasible to implement using the data available.

To a certain extent, these criteria can create a conflict for the health accountant. For example, the national policy debate may dictate the use of a categorisation schedule very different from that found in other countries.

But like the people they serve, national health systems exhibit as many similarities as they do differences. The differences, which can be traced back to culture, history, economic organisation and sociopolitical dynamics, present a challenge not only to policy makers interested in adopting best practices in health delivery and financing from around the world, but also to health accountants interested in adopting best practices in measuring national health expenditure. Fortunately (at least for health accountants), the fundamental building blocks of health systems – the entities that make them up – are fairly similar across nations. National health systems tend to perform many similar tasks and functions, often with institutional entities that have similar characteristics. Consequently, the classification schemes used can be quite similar across national systems. Ready-made classification schemes exist for some of the dimensions mentioned above, although not all these schemes were developed specifically for health accounting.

The international classification for health accounts

NHA methodology adopts its basic principles of health accounting from the System of Health Accounts (SHA) of the OECD. The SHA manual provides the International Classification for Health Accounts (ICHA) scheme, which categorises each type of health expenditure. However, SHA classifications have been most useful for countries in which a single source of health spending dominates, as in

most OECD member states. NHA uses ICHA, but disaggregates the categories/classifications further, according to the needs of an individual country. This flexibility allows NHA to accommodate expenditures in the more pluralistic health systems often found in middle- and low-income countries, where providers may receive payment from multiple financing sources and where payments may be made to numerous providers.

The ICHA is a comprehensive classification system in three important NHA dimensions: financing agents, providers and functions. It is designed to be compatible with a number of existing classification schemes and practices in international economic statistics – most importantly, with the system of national accounts (SNA).⁴ The ICHA classifications in the OECD system of health accounts (SHA) are accompanied by detailed definitions of each item in the scheme.

There are several reasons why health accountants should use international classification schemes as the basis for their work. One reason is that doing so makes cross-national comparisons of health expenditure possible. Another reason is that international schemes have already undergone considerable review and validation, and using them can save the time and cost of developing a schedule from scratch. Yet another reason is that significant economies of scale are to be found in using classifications in common with those used by national income accountants. Also, as has been mentioned, the intrinsic similarities among national health systems make it likely that the international schemes can be applied in a fairly straightforward manner.

Criteria for measuring health expenditures

The following criteria should be considered when countries are deciding how to collect, select, and measure health expenditures:

Transparency: There should be clear documentation of the sources of the expenditure data, the classifications and definitions used, and any adjustments or calculations. Typically, this requires preparation of a written manual for NHA estimates in each country.

Policy relevance: Health expenditure measures should be constructed to ensure inclusion of everything that is relevant to a country's health policy development efforts.

Compatibility with existing international standards and practices: Health expenditure measures should be compatible with international standard classifications and definitions, such as those of the System of National Accounts and government finance statistics. Where there are departures from these standards, they should be clearly documented.

Measurement feasibility: It should be feasible to compile and validate health expenditure measures within a reasonable time (less than a year) and cost.

The NHA framework and classification system

At its broadest level, NHA measures health spending as a percentage of the GDP. The *basic* NHA framework organises and tabulates health spending data in the form of a number of matrixes or tables. Each of the two-dimensional tables indicates the flow of funds from one category of health care entity to another, that is, how much is spent by each health care dimension and to where those funds are transferred. Each health care dimension in the tables is categorised according to the ICHA proposed in the OECD SHA methodology. NHA identifies *four* principal categories of health care entity within a health system:

Financing sources: These entities answer the question “where does the money come from?” They are entities that provide health funds.

Financing agents: These entities shed light on “who manages and organises the funds? They receive funds from financing sources and use them to pay for health services, products (e.g., pharmaceuticals) and activities. This is an important category because the programmatic responsibilities of financing agents give them influence or actual control over how the funds are used.

Providers: These are the end users or final recipients of health care funds. Providers are entities that deliver health services. This health care category answers the question “to whom did the money go?”

Functions: These are the services or activities that providers deliver with their funds. Information at this level answers the question “what type of service, product, or activity was actually produced?”

Based on these, it is recommended that countries should estimate at least four tables that indicate the flow of funds from: financing sources to financing agents; financing agents to providers; financing agents to functions; and, providers to functions.

Reading NHA Tables

Within the NHA tables, the funds flow downward, from the originators listed for each table column, to the recipients/users listed for each row. The amount spent by each originator is indicated at the bottom of each column. The total amount received by each recipient/user is included at the end of each row. NHA tables are also linked to each other as they trace the flow of funds from financing sources to financing agents to providers to functions. The sample in Table 6.1 indicates the flow of funds from sources to financing agents.

Table 6.1: A sample NHA matrix: Sources by financing agents

Financing agents	Sources						Total
	Federal governments	State governments	Local governments	Firms	Households	Donors	
Federal ministries							
State ministries							
LGA health departments							
Health insurance							
Out of pocket							
NGOs							
Total							

The second sample table (Table 6.2) indicates that the row headings (recipients/users) of one table become the column headings (originators) of the next table. Thus, the row totals of the first table become the column totals of the second table. For example, in the financing agents to providers table, the state ministry of health distributes its health funds to public general hospitals. Similar tables can be given for the other two recommended matrixes.

Table 6.2: A sample NHA matrix: Financing agents by providers

Providers	Financing agents						Total
	Federal ministries	State ministries	LG health departments	Health insurance	Out-of-pocket	NGOs	
Government facilities							
Private facilities							
Mission/NGO facilities							
Chemists/Pharmacies							
Traditional health care							
Others							
Total							

Additional tables

In addition to the four principal health care dimensions discussed previously (i.e., financing sources, financing agents, providers and functions), NHA suggests additional dimensions, such as:

Beneficiary Groups: Refers to the groupings of people who receive health care goods and services. These can be grouped according to socioeconomic status (SES), location of residence (R) (e.g., urban/rural), age (A) and gender (G). Classification by such beneficiary groups allows for a significant analysis of resource allocation, equity and distributional issues in health spending.

Health Problems, Diseases, Interventions (D): Refers to the classification of health expenditures according to specific measures of health and disease, or policy issues, such as interventions addressing HIV/AIDS, malaria, or reproductive health.

Inputs (I): Includes specific types of inputs used to provide services, such as labour, drugs and pharmaceuticals, and medical equipment.

These additional classifications can be used to organise health expenditure information in a way that responds to important health policy priorities. For example, policy makers might want to allocate resources more equitably among geographical areas; in such a case, a beneficiary group breakdown by urban and rural areas might be useful.

This expenditure information, when combined with other data such as health outcome information, can better indicate whether current expenditures and services translate into adequate health gains.

To make use of these new categories, several additional tables are proposed: the distribution of total current expenditure on health (TCEH) across population age and gender groups (FA x A/G); the distribution of health expenditures across region (FA x R); the distribution of current expenditure on health by financing agents to the population classified by per capita household expenditure quintile (FA x SES); allocating different types of inputs by financing agents (FA x I): classification of inputs are for those goods that are used to produce health care and health-related services; and the distribution of current expenditure on health by financing agents to the population classified by disease group (FA x GBD).

Preparing any of these tables requires additional data or calculations to disaggregate health expenditures into these categories.

The NHA Estimation Process

NHA estimation consists of the following steps: setting up appropriate management mechanisms like the technical team and the steering committee, collecting health expenditure data, organising the data into the NHA tables, analysing the results for health policy, and disseminating the information to a wide range of stakeholders.

The NHA team and steering committee

A successful approach to producing valid and reliable NHA results that have credibility with decision makers is to form a multidisciplinary NHA team that will do most of the detailed technical work, along with a more policy-oriented steering committee. The NHA team should comprise members who work for various government agencies, both to ensure broad organisational representation and to make accessible diverse data sources that otherwise may not be known to other team members. The team should include members who are familiar with national economic statistics and accounting practices, knowledgeable about health systems and policies, and experienced with data analysis. They should have report writing and data collection expertise as well. It is also useful to have a health economist on the team. Such a team can facilitate careful interpretation of NHA results.

Initially, the NHA team members will most likely be appointed by their respective organisations. With the help of the steering committee, a permanent organisational home or structure should be found for the NHA technical staff. However, all the original NHA team members can continue to be valuable contributors to each step of producing NHA. The steering committee should include senior policy makers from the ministries of health, finance, and planning, plus other high-level stakeholders from entities such as the national statistical office, academic groups, provider and consumer organisations, and the social health insurance organisation.

The committee's tasks include:

Communicating policy concerns to the NHA team; giving feedback to the NHA team on results and findings; facilitating difficulties the team encounters while collecting data from different entities; assisting in interpreting the NHA results and drawing policy implications; and assisting the ministry of health to translate the policy implications into policy action; and supporting the NHA team in institutionalising NHA as a routine annual exercise.

The steering committee plays a key role in ensuring the institutionalisation of the NHA by establishing ownership at the nation's highest levels of policy making.

Data collection

Estimating the NHA requires extensive data collection from various ministries, donors, households, providers, and industry groups (e.g., private insurers, employers and pharmaceutical companies). Often the data collection requires additional effort to separate health expenditures from other types of expenditures or

to estimate missing data. A standard spreadsheet programme such as Excel, Lotus or QuattroPro is needed to fill and maintain the tables, enter supporting data, and facilitate calculations. Because some data sets can be quite large (e.g., those from a household survey), it may be practical to enlist the central board of statistics or a similar body to manage the information. Committed staff and accurate, complete data are key to producing a good NHA. The steering committee's role in providing access to all potential data sources is paramount. Equally important is that the NHA teams have the freedom to substitute official statistics with more accurate estimates.

To begin the process of data collection, the team should develop a data plan. The data plan sets out the course of action associated with data collection – who will collect the data, how, when and from where – to help ensure that tasks are identified and completed on time. The extent of good sources of data varies from country to country. Nevertheless, the following sources are available in most countries:

Records from national, regional and local level health authorities: These records tend to be the most comprehensive, reliable and accurate. They may not be up-to-date, however, because government accounts go through a lengthy auditing process. Auditing may create another problem, as it tends to generate two or sometimes three versions of total spending – un-audited and audited. These figures may or may not be identical, making it necessary to clarify which are correct.

Insurer records (social and private): Insurer records should include premiums paid by households and companies to the insurer, and the insurer's medical and administrative costs. Private insurance companies may be reluctant to share some of their information, particularly their loss ratios and profits. Also, insurance records may exclude an important component of data, such as payments made by households directly to the provider (co-payments and deductibles).

Provider records: These can be collected from the providers themselves or the regulatory and financial agencies, such as tax authorities or licensing agencies. Often an industry association also collects routine data for its own purposes. As is the case with private insurance companies, private providers are often reluctant to reveal their financial information for tax and other reasons, and a legal decree may be needed to mandate them to do so. Another potential issue is that, in some countries, it may be difficult to have a precise count of providers in order to get an accurate sample size for a survey. In addition, the presence of a large non-formal sector (traditional healers) may make it nearly impossible to capture reliable and accurate expenditure data.

Household survey: Household surveys are undoubtedly the most important source of information on private (household) out-of-pocket expenditures. Household data are also key for equity analysis, as they are linked to socioeconomic and demographic characteristics. Household surveys

specifically addressing health issues are conducted infrequently because they are expensive. It is possible to use household survey data from one year to estimate other years, but this extrapolation can be problematic. Broader household surveys are held more routinely, but do not necessarily include all the questions necessary to capture health care expenditures.

Donor assistance: Often, annual surveys and routine reports of all donor assistance in a country (produced by United Nations Development Programme, World Health Organisation or Ministry of Health) provide much of the necessary data. Nevertheless, issues arise with donor health expenditures: one is difficulty in determining the monetary value of in-kind donations (drugs, clinical supplies, vaccines). Another is the difference in the disbursement amounts reported by the donor and the expenditure amounts reported by the MOH. Also, when donors donate directly to an NGO or local entity without going through the ministry, the financing data are likely to be missed – besides which, sometimes donors don't want everybody to know how much they are really giving anyone.

The following are some ways to avoid or surmount these common data collection problems:

Identify sources of independent data that can be used for validation/verification; try to obtain the same estimate from at least two sources; when estimates differ, determine what a “large” difference is and don't waste time trying to reconcile small differences. Use the data from the more reliable source and document the discrepancy; and when discrepancies in estimates appear to be large, examine the estimates more carefully: Was the same item measured? Were the boundaries the same? Was the time period the same? Was one accounted for on a cash basis, while the other was on an accrual basis?

Interpreting data for policy purposes

The estimation of expenditures and financing flows by NHA provides a solid indicator of the “financial health” of a health system, and this can be used as a strategic planning tool. The value of NHA is not the findings themselves, but rather, the “so what” questions that the findings can answer. For example, Jordan spends 9.2 per cent of its GDP on health care. This information in itself is not as meaningful as the answer to “*so what* if Jordan spends so much on health care?” On comparing this level of expenditure with health outcomes in Jordan, or with other countries in its socioeconomic category, the answer to the “so what” question becomes apparent – this level of expenditure may be unsustainable for a country that is experiencing slow economic growth. The policy implication, then, is cost-containment in the health system. In other words, NHA results must be analysed in terms of the broad policy context.

The full value of NHA is in a three-step process – obtaining NHA results, interpreting the results, and implementing appropriate policy. The NHA technical team, the steering committee and the legislative body of the country fulfil these tasks, respectively. The focus of the NHA technical team should be to collect and analyse data; members are not necessarily in a position to interpret the policy implications of their findings. The steering committee, consisting of policy makers and others with more of a “big picture” perspective, answers the “so what” and serves as the liaison between the technocratic NHA team and the legislature. The committee interprets the results in terms of policy implications. Given this crucial role, it is imperative that committee membership be chosen wisely. Finally, it is up to the legislative body to enact and implement a policy based on those results. The role of the legislature is crucial in passing laws aimed at ensuring that good policies are not lost in the web of political partisanship. Leadership commitment at the highest level, particularly the executive level, is also extremely important.

Institutionalising NHA estimation and use

While many middle- and lower-income countries have started using NHA for estimating health expenditures, relatively few countries have taken steps to construct a NHA on a regular and sustained basis—a process called institutionalisation. Institutionalisation is an ongoing process in which NHA activities, structures and values become an integral and sustainable part of government operations.

With institutionalisation, a department or other unit is designated to oversee the collection, analysis and reporting of health expenditure data in a routine and systematic fashion, with the full support of the government.

This complex process can take years and multiple estimates before it is fully integrated into the country’s formal structure, but in order to ensure that NHA remains an effective policy tool in the future, institutionalisation should be a goal from the initiation of NHA.

Four steps are essential to the process of institutionalising NHA, these are :

Creating demand: For policy makers to be willing to invest time and resources in NHA, the benefit of the investment must be visible. Producing NHA estimates is only part of the process; the activity alone does not guarantee that results will be used for “evidence-based” decision making. NHA must be channelled to the appropriate audience, reaching those who are in positions of power and are able to influence decisions. NHA reports should be disseminated in easily understandable formats, such as oral presentations and written briefs, that stress policy-relevant aspects of the findings. Dissemination ideally happens soon after findings are reached, but it should also be timely, because timing is important to creating demand for the information. For example, dissemination should be coordinated with the

legislative schedule. Initial dissemination should be followed by periodic updates and summaries. By establishing a mutually beneficial relationship between NHA estimates and the policy makers who will use them, the NHA team can lay the foundation for institutionalisation.

Institutionalising NHA estimation and use: NHA data should be housed in a location that will promote use of the data by policy makers. Traditional locations include: the ministry of health, the ministry of finance, the central statistical bureau, a local university, or the central bank. Often, the decision about where to house NHA hinges on how NHA findings will be disseminated and used. The location should also serve to encourage inter-institutional coordination. It is also useful to house NHA in a location with visibility, to garner political support and boost awareness of its importance. NHA also needs its own line item in the national budget, as recognition of its independent and systemised status.

Establishing standard for data collection. Institutionalisation also means that data and reporting mechanisms are standardised into a consistent format; this allows for year-to-year comparisons. Procedures and protocols should be systemised with the creation or strengthening of the country's health information system. In addition, the NHA team is encouraged to keep track of the original methodology and of any problems that arise during earlier rounds of NHA. Maintaining records offers useful insights for streamlining the NHA exercise and increasing the utility of results. In addition, keeping records guards against "memory loss" in the event that the NHA team loses key members. Safeguarding the NHA process and standardising data are critical components of the institutionalisation process.

Instituting data reporting requirements. Institutionalisation of NHA requires continual replenishment of data. This in turn requires official support for data sharing – sometimes a greater problem than overall lack of data – from NHA-relevant groups in the private as well as the public sector. By requiring the various NHA-relevant groups to report data to the NHA team, or at least to a central location, the reporting process is strengthened and becomes more integrated into the NHA structure. Reporting requirements are likely the single most important component of successfully institutionalising NHA.

NHA Estimation Experiences: Types, Approaches and Methodological Issues

Several manuals and methodology reviews have been developed to encourage and complement the national studies on health expenditures carried out in the 1970s and 1980s. Mach and Abel-Smith (1983), Griffiths and Mills (1982), and Robertson *et al.* (1979) provide detailed guidance on the structure and methods needed to compile national estimates. The manuals stress the need for estimates to be comprehensive and based on consistent definitions. They acknowledge that even

though data sources may leave much to be desired, with a bit of creativity, countries can still develop sound estimates. The review of methods by Griffiths and Mills (1983) is a useful summary of these tools and their application.

The most successful effort to date in developing standardised estimates has been that of the OECD, which now receives annual reports of health expenditures from its 25 members (OECD, 1997). The OECD provides members with a computerised questionnaire and written guidelines of definitions. OECD definitions of expenditure categories focus on expenditure “uses”. Sources are broken down by public and private sector, with social health insurance included with public sector expenditures. These categories are a combination of types of services and types of providers, and categories of inputs. Many OECD members compile somewhat different or more disaggregated expenditure accounts for their own use, but all assist in reporting comparably defined estimates for the OECD’s comparative analyses. Often, data on some of the categories are not available in a country’s report, as in the example of Rwanda, which conducted its first NHA in 1999.

In the United States, the federal government has for many years obtained the NHA estimates. The US methods meet OECD standards, but also go beyond them to estimate a detailed matrix of the sources and uses of health expenditures, with more extensive breakdowns of both public and private sources of spending. The OECD method only allocates sources of spending to “public” and “private”. The US approach is particularly useful in pluralistic health care systems, where finance comes from multiple sources and where providers may receive payment from more than one source. It is less useful where a single source of health spending is dominant nationally as in most OECD member states. However, such pluralistic health care systems are becoming more common in developing countries.

The core concept of NHA is defining the flow of funds. Experience in applying NHA in developing countries suggests that the approaches used in the US should be adapted to the specific needs of developing countries, as well as the more limited data available. This requires modifying definitions of both sources and uses. There may be several levels of sources of funds before one reaches the level of financing agent, but in most cases we would be primarily interested in those that provide funds to the financing agents directly. In some countries, it has been of significant policy interest to trace expenditures back to these ultimate sources in order to analyse the equity of spending patterns (Selowsky, 1979; Meerman, 1979).

Costing Reproductive Health

Implementing the ICPD Programme of Action and enhancing reproductive health across the globe require a variety of reproductive health activities. These activities must be financed. However, given the growing scarcity of resources for basic reproductive health and family planning, on the one hand, and rapidly expanding needs for HIV/AIDS prevention and treatment, on the other, financing reproductive health becomes a significant public health issue. The reluctance of the public sector

to be more involved in health care financing and health care delivery, and the long-term consequences of poor reproductive health for mothers, further reinforces the importance of this issue.

Few studies investigate the expenditures for reproductive health, including family planning. The United Nations Population Fund, Joint United Nations Programme on HIV/AIDS and the Netherlands Interdisciplinary Demographic Institute (UNFPA/UNAIDS/NIDI) engaged in primary data collection on donor assistance for population and AIDS activities at the global and regional levels (UNFPA, 2002). In the 2003 round of the Resource Flows project (survey RF 2003), data collected are derived from detailed questionnaires mailed to 77 donor countries, multilateral organisations and agencies, development banks, major private foundations, and other international NGOs that provide population and AIDS assistance. The project also collected information on domestic resource flows by national governments and local NGOs in developing countries and countries-in-transition pertaining to expenditures on activities included in the ICPD costed population package, which is included in the ICPD Programme of Action (paragraph 13.14). The Cairo goal was to mobilise US\$17 billion by the year 2000 and US\$18.5 billion by 2005 for population and AIDS activities: family planning, basic reproductive health services, sexually transmitted diseases (STDs) and HIV/AIDS activities, and research and data collection. According to the Programme of Action, approximately two-thirds of the projected resources was expected to come from developing countries and one-third from the international donor community.

The RF project conducted a study on the worldwide size and structure of funds for population and AIDS activities, generated by donors and the governments and NGOs in developing countries and countries in transition for the years 2003–2005 (Van Dalen and Reuser, 2005). The focus of this report was the question of whether the financial promises made at ICPD were likely to be fulfilled in the coming years. According to the study, the total flow of resources was expected to increase from US\$14.2 billion in 2003 to US\$18.5 billion (current US dollars) in 2005. This amount comprised resources from both donors and domestic organisations in developing countries/countries in transition, including a significant share of private out-of-pocket expenditures. The following conclusions can be drawn from the findings:

The Programme of Action targeted a sharing of costs between donors and developing countries of 1:2. For 2005, donors did indeed provide approximately one-third of total generated funds: US\$5.9 billion in nominal terms. Domestic expenditures would account for US\$12.7 billion. However, more than half of the funds in developing countries and countries in transition constitute out-of-pocket expenditures by consumers. Given this prominent position and the concern for poverty in the developing world, it would be prudent to strengthen the involvement of all public and private

stakeholders, including profit and non-profit firms, in population and HIV/AIDS activities to alleviate the financial burden for consumers.

On average, donors are living up to their commitment by giving more than the aimed 4 per cent of ODA to population and HIV/AIDS issues. Yet, a large share of a recent increase is attributable to only one initiative, the United States President's Emergency Plan For AIDS Relief (PEPFAR), which committed US\$2.7 billion to HIV and AIDS in 2005.

In nominal terms, the ICPD worldwide goal for 2005 is likely to be met. However, a dollar today cannot buy the same basket of goods and services it did in 1993 – the time when ICPD targets were developed. To allow comparison across time, 2005 figures could be stated in 1993 dollars to correct for inflation. If this were done, the question of whether the 2005 ICPD goal will be achieved would have to be answered differently.

Given the dramatic AIDS pandemic and the skyrocketing health-care costs in general, a financial target considered reasonable in 1993 is no longer sufficient to cover expenses in 2005. Therefore, attention should be given to the question of whether the 2005 ICPD target is adequate to meet the increasing needs of developing countries/countries in transition in the fields of family planning, reproductive health, STD/HIV/AIDS and basic research.

The fact that the world today is very different from what it was at the time of ICPD is also revealed by the shift from family planning and reproductive health to HIV and AIDS activities. This change will probably be the most dominant trend among the OECD/Development Assistance Committee (DAC) countries. In 2005 it was expected that 66 per cent of donor funds would be allocated to STD/HIV/AIDS activities. This in marked contrast to the 8 per cent targeted share was mentioned in the ICPD Programme of Action for 2005. The other elements of the ICPD costed population package were crowded out by the drive to fight HIV and AIDS.

Resource tracking is an active field of research. In addition to the RF project study, a number of studies examine global funding of reproductive health, in particular donor funding, and investigate the extent to which funding has met the ICPD estimates of resources needed. Eisenman and Fossum (2005) provide a recent overview of actors and activities in RH. The studies include Potts *et al.* (1999), Claeys and Wuyts (2004), McKellar (2005), and Kates (2005).

The International Planned Parenthood Federation (IPPF) organises shadow peer reviews of donor countries, i.e., countries that are members of the DAC. By publishing the reviews in *DAC Watch* (a publication of OECD/DAC), IPPF aims to raise donor government awareness of the need to contribute to sexual and reproductive health programmes. In collaboration with relevant national family planning associations and other NGOs, IPPF initiated an independent evaluation of countries under DAC review. Population Action International (PAI) publishes

overviews of donor performance with regard to their financial and political support for international reproductive health and population programmes (Conly and de Silva, 1998; Ethelston *et al.*, 2004). The overviews, which rely to a large extent on data of the RF project, profile the donor countries and grade each of them on their contributions toward the goal of universal access to basic reproductive health care by 2015 – The ICPD 1994 agreed goal. They also address donors' growing focus on HIV/AIDS and the importance of linking HIV/AIDS services to other aspects of sexual and reproductive health care. These activities call for coordination. In 2004, the Centre for Global Development in Washington, D.C., established the Global Health Resource Tracking Working Group, involving the major actors in the field. The Working Group drew up a number of recommendations for global health resource tracking (Global Health Resource Tracking Working Group, 2005).

The tracking of donor expenditures on sexual and reproductive health is relatively well developed, but information on domestic expenditures is difficult to obtain and generally requires detailed fieldwork, since accurate monitoring and accountancy systems are often missing. The Institute of Policy Studies in Sri Lanka reviews costs and financing of reproductive health services in Bangladesh, India, Nepal, Pakistan and Sri Lanka (IPS, 2004). Revealing large gaps in the available evidence base and existing information systems, their study indicates that the only countries and states for which financing for reproductive health services can be easily quantified are those that have established health accounting systems (Bangladesh, Sri Lanka), or recent health accounting studies of reproductive health expenditures (Rajasthan). In only these territories do databases exist that systematically quantify and classify public expenditures by purpose, and thus enable ready identification of reproductive health service expenditures and costs. Household out-of-pocket expenditures are a substantial source of financing in all countries, but again, only in those territories with health accounting systems, have, the level and composition of household spending been reliably quantified. In all countries, existing household surveys of expenditure and utilisation suffer limitations in respect to the detail of their coverage of reproductive health. As for the costs of public sector services, similar limitations exist owing to the lack of reliable and representative facility cost studies outside of Bangladesh, Sri Lanka and a few Indian states (IPS, 2004).

Rannan-Eliya *et al.* (2000) assessed the financing of family planning and reproductive health services in Egypt and Sri Lanka. The study identified important differences in the performance of the reproductive health system in the two countries. It revealed that reproductive health expenditures (per capita) in Sri Lanka and Egypt were comparable, with similar contributions of the private and public sectors. Expenditures on reproductive health were 14 per cent of all health expenditures in Egypt (1994/95) and 11 per cent in Sri Lanka (1997). Public sources (including donor assistance) accounted for two-thirds of reproductive health expenditures (Rannan-Eliya *et al.*, 2000:46). Family planning and MCH services accounted for the smallest share of reproductive health costs, whereas the

largest cost components were general obstetric and gynaecological care and childbirth services.

The Indian Institute for Health Management Research (IIHMR) in Jaipur, India, and the Futures Group International (FGI) in Washington, D.C., joined forces to investigate the reproductive and child health financing in Rajasthan, India (Sharma *et al.*, 2000). In the fiscal year 1998/99, the state of Rajasthan spent 6 per cent of the state domestic product on health care, the same percentage as India. The Government of India (GOI) and the Government of Rajasthan (GOR), with donor assistance, finance about 29 per cent of health care services, while household spending constituted 71 per cent of the total. Of the 71 per cent, households allocated 66 per cent to direct payments to private providers and 33.6 per cent to payments for services initiated in the public sector. Less than 1 per cent of household spending went to pay official user charges in public facilities. Of the total state health care expenditure, 21 per cent was for reproductive and child health (RCH). These services are a significant part of primary health care. They attend the immediate, basic needs of women of fertile age and of young children and infants by providing services like family planning, delivery assistance, immunisations, abortion, treatment of reproductive tract infections and others. They also support public health measures that aim to halt the spread of sexually transmitted infections including HIV. In the study period, the GOI and GOR financed only one-fifth of RCH services in the state.

On an out-of-pocket basis, households financed four-fifths of RCH services. Their direct payments to private providers constituted nearly half the services financed (49 per cent). They also made payments to public providers (31 per cent of total RCH spending). It is interesting to note that public institutions received far more of their financing from households than from governments and donors (31 versus 20 per cent). A surprising result of this study was that the treatment of reproductive tract infections (RTIs) accounted for almost half of all RCH expenditures. RTI accounted for 41 per cent of RCH expenditures, of which 9 per cent is spent by the government and 91 per cent by households. The high expenditures for RTI are related to the high prevalence of such infections. More than one woman in three (37 per cent) reported RTI-related symptoms in the past three months (vaginal discharge that is not menstruation, pain or burning while urinating, pain in the abdomen during intercourse, or blood after sex when not menstruating). Only 20 per cent of those who reported a symptom reported seeking medical help, mostly from private providers, although private providers charge three times the cost charged by government providers. Half of the expenditures for RTI treatment were for medicines.

Standing (2002) examined the impact of different financing regimes on the delivery of reproductive health services in low and middle income countries. She investigated the shift in balance between collective and individual responsibility for reproductive health and found that the move towards individualisation has produced a plethora of new financing arrangements. The rising cost of medical care means

decreasing access to services, especially for the poor. The study also raised a critical note on expenditures studies. In Africa, the public health sector is increasingly becoming fiction as poorly paid and supervised health staff become personal entrepreneurs. Budget allocations are almost irrelevant when the institutions that manage them are weak and lack accountability (Standing, 2002:5). She concluded that, in understanding the relationship between financing and outcomes at the level of service delivery and health gain, unofficial financial flows, such as informal payments and other costs of access to services, are as important as official ones” (p. 6). She also discusses ways to monitor reproductive health spending, which may cover informal payments, such as, through NHA and budget studies.

Zeitlin *et al.* (1994) attempted to review the available data on funding for reproductive health services in developing countries. They found that while data on international funding for population services did exist, information on domestic funding of reproductive health is elusive, and certainly nonexistent, in an internationally comparable format. They noted as problems the almost complete lack of information on private expenditures for reproductive health services, the lack of disaggregation of national government budgets in a manner permitting suitable analysis, and the lack of clear, unambiguous procedures for collecting data on these expenditures. With integrated FP/RH services, methodological difficulties and inconsistencies have prevented meaningful analysis of true economic costs and differences between countries and strategies (Janowitz and Bratt, 1992; Janowitz, 1993; Aitken and Reichenbach, 1994). The paucity of data prevents meaningful estimates of the resource requirements for FP/RH, at both national and global levels. Little is known about cross-country variations in unit costs of provision by public and private sectors, and factors explaining differences in efficiency, and thus the importance of technical inefficiencies in the delivery of services as an issue for policy makers.

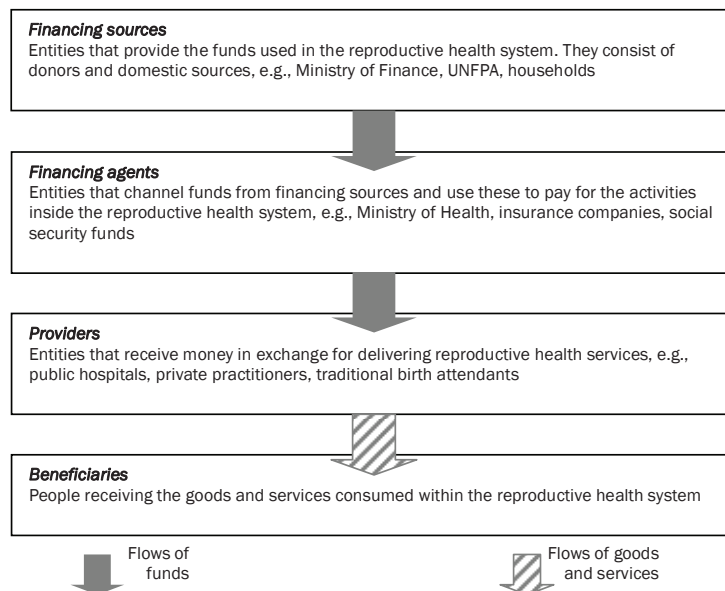
The major limitation of the approaches reviewed so far is that they fail to track the flow of financial resources between the various stakeholders in the funding of RH. Only a health accounting (HA) framework can do this by developing as framework for implementing an HA for reproductive health.

Constructing Reproductive Health Accounts: Some Important Considerations

Like NHA, the RHA is basically a set of origin-destination tables that present financial flows related to reproductive health goods and services between categories of stakeholders in a particular country: financing sources, financing agents, health care providers and beneficiaries (Figure 6.1). These actors include public, private (including households) and donor entities. To identify and classify the different categories of actors and activities, the RHA draws on the International Classification for Health Accounts (ICHA) by OECD. The organisation of

information about who pays, how much and for what in RHA is consistent with the widely endorsed methodology of NHA, since RHA is a satellite account of NHA.

Figure 6.1: Actors and flows in RHA



Source: UNFPA (2002).

The Boundary

According to the general guideline by WHO on setting the boundary of national health accounts (WHO, 2003: 20), the boundary of the RHA is determined by a set of activities that are related to reproductive health, space (geography) and time.

The activity boundary

Reproductive health expenditures encompass all expenditures for activities whose primary purpose is to restore, improve or maintain reproductive health for individuals during a specified period of time. The “primary purpose” is inferred from the type of good or service purchased, or determined from the stated intention of the purchaser. This definition applies regardless of the institution or entity providing or paying for the health activity.

Activities of RH care include: Promoting reproductive health and preventing reproductive health related disease; curing reproductive health related illness and reducing maternal mortality; nursing persons with illness or impairment related to reproductive health; and providing and administering reproductive health service and programmes, including those for family planning and HIV/AIDS.

At a minimum, the RHA should cover expenditures incurred on reproductive health services and STD/HIV/AIDS activities listed by the Programme of Action of the ICPD (paragraph 13.14). As a convention, health accounting excludes activities that do not involve financial transactions for goods and health services delivered by family, friends and volunteers. However, it is advisable to expand the RHA to include informal payments, since they often represent an important part of service delivery and may contribute significantly to the health level of the population. The WHO manual notes that decisions to include or exclude activities and transactions are, in a sense, arbitrary. The goal of health accounting is to be consistent in making such decisions, and to document those decisions thoroughly for later reference and comparison.

The time boundary

The time boundary of the health account has two elements. First, a particular period must be chosen within which the activities took place. Most often this is a fiscal or a calendar year. Government entities often report spending on the basis of a fiscal year, while private entities tend to report by calendar year. The WHO manual includes procedures to adjust the time frame to assure comparability.

The second element of the time boundary is the distinction between the activity and the transaction that paid for the activity. Funds may be released in a year that is different from the year in which the activity takes place. In *cash accounting*, expenditures are registered when the actual cash disbursement takes place. In *accrual accounting*, expenditures are attributed to the time period during which the economic value is created (by the activity taking place). The manual recommends the accrual method. Funds that are received in a given year to be used over several years should be recorded that way. For example, when funds are used in equal parts over three years, one third should appear in each year of the RHA (WHO, 2003: 43).

In the RF project by UNFPA/UNAIDS/NIDI, the second element of the time boundary is exemplified in the distinction between primary funds for population assistance and final expenditures on population activities. Primary funds refer to the financial resources contributed by a primary donor for population activities. Primary funds also include self-generated income of intermediate donors as well as contributions that they receive from donor countries that are not members of OECD/DAC. Primary funds reflect the money originating from donors in a given year. They are recorded in the year of allotment or allocation of funds (cash accounting). Final expenditures reflect the funds provided to a final recipient in a given year. They refer to funds that have been received by developing countries and countries in transition directly from donor governments and international foundations, or through intermediate donors. The final recipients may be domestic governments, national NGOs, or donors' field offices in developing countries and countries in transition. Final expenditures are attributed to the year during which the activities take place (accrual accounting).

The space boundary

The NHA for a country captures the health expenditures by *the usual residents* of that country. The accounts include spending on health care by citizens and residents who are temporarily abroad, as well as spending by external agencies on inputs to health care within that country (WHO, 2003:22). The accounts exclude spending in the country by foreign nationals (which is treated as “export” of health care). This procedure is particularly significant in countries with a large foreign population, e.g., refugees.

The RF project also encounters problems related to the space boundary. Final expenditures on reproductive health in developing countries include expenditures on activities in developed countries, such as research, that benefit more than one developing country and country in transition.

As in NHA and following WHO (2003), four types of actors can be identified, these are financing sources (FS) which are institutions or entities that provide the funds used in the system by financing agents. They consist of donors and domestic sources; financing agents (FA) which are institutions or entities that channel the funds provided by financing sources and use those funds to pay for, or purchase, the activities inside the health account boundary; providers (P) which are entities that receive money in exchange for or in anticipation of producing the activities inside the reproductive health account boundary; and, beneficiaries which is those receiving or affected by the goods and services consumed within the health account boundary.

Financing agents may pool health resources from different sources or may use their own resources (e.g., self-generated income) to pay directly for health care. They include households that purchase health services using out-of-pocket payments and firms that purchase health services for their employees.

Providers are paid for their goods and services directly by consumers of health care, or by financiers or the government. Different countries have different systems of paying providers. Four types of systems may be distinguished (Borghuis-Lub *et al.*, 1994:45ff). They are:

Transaction system: The provider is paid directly by the consumer for goods and services provided. The price is generally determined by the market.

Insurance system: The insurer is a third party between the beneficiary and the provider of health care. Health insurance is basically an instrument to share the risk of excessive health expenditures. In the presence of insurance, the out-of-pocket expenditures for health care are independent (to some degree) of the consumption of health care. Beneficiaries do not pay directly for goods and services, but they pay a premium to the insurer who in turn pays for the goods and services from the premiums collected from all participants in the insurance system. The list of goods and services covered by the insurance is

governed by a contract between the beneficiary and the insurer. Insurance can be voluntary or compulsory. Insurance can be organised by the government or by the private sector (or a combination). A particular type of insurance is social security, which is an insurance established by law. Everyone who meets eligibility criteria established by law is insured. In some cases, insurers directly engage in providing health care. In this *integrated model*, providers are not independent of the insurers.

National system: In the national system, health care is financed entirely or in part from tax revenues. Participation is compulsory and contributions are generally dependent on income. Goods and services are provided free of charge. Providers generally have a fixed budget to cover costs.

Capitation fee system: In this method of payment, the provider of medical services is paid a fixed period fee for each person served or member of the scheme. (Capitation means by the head, or per person.) The total payment is according to the number of members in a health benefit plan that the provider contracts to treat. Because the fee is independent of how many services are performed, the doctor has an incentive to keep costs low. It also promotes preventive care. For more information, see Wouters *et al.* (1998), among others.

Financing sources (FS). The guiding principle adopted by WHO for classifying financing sources is human behaviour. The WHO manual distinguishes among funds that in economic theory elicit different behaviours. Consumers of health care behave differently in response to a given out-of-pocket charge than they do in response to the same amount charged as a health insurance premium or levied as an income tax, or when the amount is paid by the employer.

Table 6.A1 in Appendix A indicates the WHO classification scheme for financing sources. The classification distinguishes three broad categories of financing sources (FS): the public sector; the private sector; and, the international donor community and the multinationals. Category FS 1.2 includes funds generated by government on trust funds or other assets and FS 2.4 includes funds generated by private entities. The FS 3 category is reserved for funds that come from outside the country for use in the current year. These include external funds from bilateral or multilateral donors and funds contributed by institutions and individuals outside the country (e.g., remittances). External sources traditionally have accounted for an estimated 25 per cent of global spending on family planning, and they have tended to be most important in the poorest countries (Potts *et al.*, 1999). About three-quarters of all family planning expenditures have come from developing country governments and consumers. According to conservative estimates, private consumer spending accounts for about 14 per cent of global spending on family planning (Conly *et al.*, 1995; Potts *et al.*, 1999). The PHRplus Project provides NHA-based estimates of out-of-pocket health expenditures in Middle East and African countries that range from 15 per cent to 54 per cent (PHRplus, 2002). A compilation of HIV/AIDS

expenditure statistics by UNAIDS (2004) reveals a range of 10–93 per cent for the share of households. For the Indian State of Rajasthan, a household contribution to reproductive and child health of 80 per cent was found (Sharma *et al.*, 2002).

In tracking resource flows for reproductive health (costed package), the UNFPA/UNAIDS/NIDI Resource Flows project adopts the notion of donor. A donor is a financing source located outside of the country. Three types of donors are distinguished: (a) *primary donors*, which are the developed countries (OECD/DAC members) and private foundations; (b) *intermediate donors*, which are multinational organisations and agencies (mostly UN organisations), international NGOs and research institutes/universities that channel most of the primary donor's funds for population and AIDS assistance; and (c) *development banks*. An overview of donors included in the 2004 survey round of the RF project is provided in Appendix B. In addition, the RF project distinguishes two types of domestic sources (in developing countries and countries in transition): (a) *central governments* and (b) *national NGOs* that operate exclusively in one country.

Financing agents (FA). Financing agents are the institutions and entities that pay for or purchase health care. They include institutions that pool health resources collected from different sources, as well as entities (such as households and firms) that pay directly for health care from their own resources (WHO, 2003; 36). The WHO manual adopts the OECD classification of financing agents (Table 6.A2 in Appendix A). The classification of expenses in mutually exclusive categories is often problematic because of several cost-sharing mechanisms. Health care costs may be covered partly by government or insurance and partly by out-of-pocket payments. Deductibles under health insurance schemes are an example. Goods and services delivered under a social marketing programme represent another situation where costs are shared by the beneficiary and a government or non-government organisation. Cost-sharing has the possibility to maintain acceptable levels of reproductive health activities when public resources decline, provided that market segmentation is used to determine those individuals most in need of the subsidised services (Gribble *et al.*, 2004). The need for targeted cost recovery schemes is also stressed by Sanderson and Tan (1995:89).

In the WHO classification, three types of insurance schemes are distinguished. They differ a little from the funding schemes presented above. Social security schemes (HF 1.2) are those in which participation is required by law or regulation. Although social security funds are closely tied to governments, they are separately organised and hold their assets and liabilities separately from the government. Social insurance schemes are collective schemes whose enrolment is restricted to subsets of the population; typically, to be covered one must be an employee (or retiree) of a sponsoring firm or association (e.g., trade union) or a family member of such a person. Other private health insurance (HF 2.2), often called voluntary medical insurance, is potentially available to any member of society who can afford to buy it.

The development of health accounts at a disaggregate level, i.e., for population groups, specific diseases or geographic units within a country, raises additional problems of distinguishing between primary financing sources and financing agents. De *et al.* (2004a:27), for example, discuss classification issues raised in the development of subnational health accounts in Ethiopia, where – as in many other countries – more than one level of financing source can be identified. In Ethiopia, the Ministry of Finance gives block grants to Regional Finance Bureaus (RFBs) and all major decisions on spending are done at the regional level. RFBs give funds to regional health bureaus. De *et al.* decided to term the regional/local government as the “Financing source” of funds disbursed by RFBs. If the central government is indicated as the “source” this would greatly diminish the role of RFBs and would not accurately describe how the health system is organised. A similar issue arises in accounting for the spending by donors for funds given to a central government to allocate to regional governments. The donor is the ultimate financing source and the central government is the financing agent. The regional government is a financing agent too. Consequently, in a multilevel system, different financing agents can operate at different levels. Treating donors rather than the central government as the financing source provides a better reflection of a country’s dependence on external assistance.

Health care providers (P). Often the end-users of funds, providers answer the question, “Where does the money go?” Providers include hospitals, clinics, primary health centres, traditional health care institutions, pharmacies and researchers (Berman, 1997). They also include independent physicians, nurses and other health personnel. Providers may also include organisations that provide information, education and communication (IEC) services aimed at promoting healthy lifestyles and preventing illnesses. Health care providers include international non-government organisations such as the Red Cross or Red Crescent, Doctors without Borders (Médecins sans Frontières), Oxfam, Save the Children, Caritas, Marie Stopes International, Family Health International, and so on. They also include for-profit organisations such as private clinics, traditional healers, pharmacies, doctors and diagnostic centres, as well as non-profit and community-based organisations such as religious groups, trade unions and other NGOs.

Several classification schemes of the health care providers exist. Widely used ordering principles include the following:

Classification based on the location of health care services

- Whether within or outside the premises of the organisation
- Residential and ambulatory

Classification based on position of provider in health care chain (access)

- Primary health centres and physicians
- Referral institutions

Classification based on target population

- Mother and child health centres
- Health care for the elderly

Classification based on type of intervention or function of care

- Prevention (including promotion activities)
- Curative
- Revalidation
- Care (e.g., home nursing, palliative care, home-based care)

Classification based on ownership

- Government or public sector
- Privately owned
- Owned by NGOs

Classification based on type of medicine

- Allopathic or Western medicine
- Traditional medicine

(The non-allopathic health system may include hospitals and dispensaries, research and training institutions.)

The WHO manual recommends a classification of health care providers that is an extension of the OECD ICHA-HP classification scheme. The scheme is indicated in Table 6.A3 in Appendix A. A health care provider may provide several reproductive health services and several providers may be involved in a single service. Antenatal care, for example, may be provided by midwives, primary or community health centres, district-level health centres, general government hospitals or other government facilities, private clinics, hospital outpatient departments, or private physicians.

A useful source on providers of family planning services in a given country is the Demographic and Health Survey (DHS). Providers play an important role in the promotion and maintenance of family planning practices, for instance, contraceptive use, in the population is revealed, for example, in the 1996/97 Bangladesh DHS (BDHS). This survey classifies the sources of family planning services into five major categories: government facilities (including *thana* – a term used in South Asian countries that is synonymous with police station or precinct – health complexes, family welfare centres, clinics and hospitals), private medical sources (including private clinics, doctors and pharmacies), fieldworkers (who may be either government or non-government) and clinics run by NGOs. Fieldworkers (often known as community-based distributors) remain the largest source of family planning methods. The DHS also reveals that the proportion of users who buy their methods from pharmacies and shops is increasing. This finding indicates that the number of users willing to pay for family planning supplies or services has been

rising. Pill users are more likely to pay for this method than users of other methods. Since the relative importance of different providers is influenced by their willingness to pay for family planning and reproductive health services and commodities, changes in the willingness to pay will result in changes in the share of providers.

The increased willingness to pay for family planning services and commodities and the shift from government providers of health care to private providers are important trends in the reproductive health system. That shift is documented by resource tracking and the financial information it provides on who pays, how much and for what. That shift may signal significant underlying changes in the health system. For example, the study in Rajasthan, India (Sharma *et al.*, 2000), discussed earlier, revealed that many people seek medical help for RTIs from private rather than government providers, even though private providers charge three times the cost charged by the government sector. The authors explain the observation by the fact that government facilities often fail to provide confidentiality and attention with dignity to the users of such services (Sharma *et al.*, 2000: 34). Differences in (perceived) quality are also the reason why many individuals, even among the poor, obtain their contraceptives from private sources for a fee, despite the availability of free or highly subsidised supplies. Quality improvements can more than offset the demand-reducing effects of price increases (Matheny, 2004:136–7).

A shift to private providers may also signal a change in reproductive health practice. Padmadas *et al.* (2004) find that 14 per cent of deliveries in Kerala, India, are by caesarean section and that the procedure occurs more in private than in public institutions.

Beneficiaries: Beneficiaries are individuals. They are patients or other persons in the population at large. Individuals can be classified on the basis of a range of attributes. Demographic attributes include age, gender, race or ethnicity, and place of residence. The socio-economic and health status of beneficiaries are of particular relevance. Of equal relevance is vulnerability status. Vulnerable groups include women or couples with unmet needs, i.e. persons who want to limit or space childbearing but have no access to the means to do so. They are not served by family planning and reproductive health services providers. Vulnerable groups also include people with a low ability to pay for commodities and health services. The health status and vulnerability status are not constant, but vary with time.

Of particular relevance is the variation over the life course. People at different stages of life have different needs, and early life experiences may have consequences that last a lifetime. The ICPD Programme of Action stressed the changing reproductive health needs over the life cycle while the Madrid International Plan of Action on Ageing 2002 (UN Report of the Second World Assembly on Ageing: Madrid Political Declaration and International Plan of Action, 2002) called for ensuring that gender-specific primary prevention and screening programmes are available and affordable to older persons (Madrid Plan,

paragraph 67c) further emphasizes the need for the provision of adequate information, training and care giving skills, treatment, medical care and social support to older persons living with HIV/AIDS and their caregivers (Madrid Plan, paragraph 80). An ultimate goal of reproductive health expenditures is to assure not only the adequate health status of the population, but also to assure a healthy life by meeting the reproductive health needs over the entire life course.

The classification of beneficiaries facilitates the assessment of who benefits most from reproductive health care expenditures. Benefit incidence analysis investigates the extent to which the financial benefits of public spending on social services accrue to different population groups (e.g., the poor, adolescents, older women, men) (Van de Walle, 1995; Demery, 2000). Benefit-incidence analysis has long been used in the public finance field, to determine the progress or regression of government expenditures. In recent years it has been applied with increasing frequency to the health, nutrition and population (HNP) sector – usually to determine the distribution across economic classes of overall governmental HNP spending as well as the distribution of spending on a particular type of HNP program, such as a reproductive health programme.

Benefit-incidence analysis is one type of programme or policy evaluation. It focuses on money and on the distributional or equity effects of programmes. It differs from programme incidence analysis which focuses on the volume of services delivered (number of people seen, of operations performed, of children vaccinated). It also differs from cost-effectiveness analysis, used to assess a programme's efficiency. Cost-effectiveness analysis focuses on immediate programme outputs. Incidence analysis investigates the achievement of ultimate programmatic objectives or outcomes (at the population level). Benefit incidence analysis in Madhya Pradesh, India, for example, reveals that nearly half of the public health subsidies accrue to the top two per cent of the population. The bottom quintile accounts for just 6.6 per cent of the hospitalisation. Analysis also reveals that the rich use the private sector more but they also use a much larger share of the public provision as well (Government of Madhya Pradesh, n.d.). Studies in other parts of the world also indicate that government health care benefits are significantly pro-rich (Barnett *et al.*, 2001; Mamotlohi Alina Mohanoe, 2004:9; Nandakumar *et al.*, 2004:19).

A particular type of public expenditure benefit incidence analysis disaggregates by gender. It aims at determining the extent to which men and women, girls and boys, benefit from expenditure on publicly provided services. It is a quantitative tool useful in assessing the distribution of public spending by gender. Knowles and Behrman (2000) present a list of information needed to calculate benefit incidence for services oriented towards safe motherhood.

Among them they include: service utilisation rates among the target population by income group; the proportion of the target population in the larger population of each income group (e.g., the proportion of married women of reproductive age in the total population of each income group); the proportion of services obtained from

various providers by income group (e.g., the proportion of women in each income group who obtain reproductive health services from commune health centres or from provincial hospitals); and, the unit subsidy received by each provider for each type of service.

In the Resource Flows project, the concept of beneficiary is not used; rather, the project uses the concept of final recipient instead. Final recipients include: developing countries and countries in transition that are the final beneficiaries of the programmes being funded; and national NGOs that receive funds for programmes that they themselves execute (UNFPA, 2002:9). The concept is therefore different from that of beneficiary.

The WHO manual suggests that spending on health problems can be partitioned among disease categories using the International Classification of Diseases (ICD) scheme, the WHO burden of disease classification (based on ICD-10), or other groupings. Table 6.A4 in Appendix A displays the global burden of disease classification scheme. Being able to link expenditures to specific ICD categories of groups of categories can be useful when tracking resource allocation and a step in the direction of a powerful monitoring and evaluation methodology (WHO, 2003:45). No international standards exist to guide the health accountant.

Data on reproductive health expenditures by socio-economic status and other characteristics of beneficiaries are often lacking. When expenditure data are lacking, they may be estimated using costing methods that combine information on the use of family planning commodities and reproductive health services and information on unit costs. Data on usage are generally available from surveys such as the Demographic and Health Surveys.

The activities (F)

Activities answer the question, “What types of goods and services were actually produced?” A useful way of viewing activities is in relation to specific objectives such as the reduction of unwanted pregnancies, teenage pregnancies, maternal deaths, abortions, and mother-to-child transmission of HIV, the prolongation of life for people living with HIV and AIDS, increased access to health services, increased gender equity in health, and others.

The International Classification for Health Accounts – a functional classification of health care (ICHA-HC) adopted by WHO (2003) – provides a way to group activities and transactions in health accounts by referring to the functions of health expenditures. This functional approach includes all expenditures on all health care activities regardless of the provider or the paying entity. In the approach, spending on non-health care or health-related entities, such as spending by the Ministry of Education on teaching hospitals and infrastructure development or research, is included.

Many classifications of reproductive health activities have been applied. Among them are those by Odumosu *et al.* (2002); Bernard and Tsui (1995); Rannan-Eliya

et al. (2000); and Sharma *et al.* (2002). Appendix C reviews some classifications. The Programme of Action of the ICPD (Paragraph 13.14) distinguishes four categories in the costed-population package: family planning services; basic reproductive health services; prevention and treatment of STDs and HIV/AIDS; and, research, data, policy analysis (see also Appendix D).

The RF project adjusted the list of activities covered by these categories to meet the data requirements of UNFPA and UNAIDS (see Appendix E). De *et al.*, (2004a/b) mapped the list of activities to the NHA classification scheme.

The classification of RH activities proposed here (see Appendix F) draws on the various classifications. In general, it takes into account the following considerations:

The categories of the classification must be exhaustive and mutually exclusive; i.e., all RH-related activities should be covered by the classification and they should be attributed to one category only;

The classification should only include activities whose primary purpose is to promote, restore or maintain RH. Other activities that may be associated with RH, but whose primary aim is different – e.g., infant and child health activities – should be excluded; and

Given the importance of distinguishing health expenditure and activities for men and women, the classification should be gender specific. Expenditures by function and resulting RHA matrixes should, therefore, be disaggregated by gender.

The classification should be based on OECD's ICHA-HC (see Appendix G). There are two major reasons for this: It facilitates the integration of RHA in the larger framework of NHA, and it allows cross-country comparability. The ICHA-HC provides a functional classification of activities at the two- and three-digit level. It distinguishes personal and collective health care services (respectively, codes HC.1-HC.5 and HC.6-HC.7).

Personal health care services are further subdivided according to mode of production (in-patient, day care, out-patient, home care) and to the basic functions of care (curative, rehabilitative, long-term nursing). The distinction between the functions of personal and collective services is not always obvious, especially since the ICHA-HC associates the public-personal dimension with the dimension of preventive-curative/rehabilitative care. In practice, this parallel distinction cannot always be maintained and practical solutions should be found for adequately classifying all activities. The proposed functional classification for RH care assigns a relatively large weight to the distinction between preventive and curative/rehabilitative care as criterion to categorise activities.

A relevant example of inconsistency in the ICHA classification relates to the HC.6.1 category, which is crucial to RHA since it includes maternal health, family planning and counselling. This health area comprises public and personal care components, as well as preventive, curative and rehabilitative elements. The present

elaboration of the classification scheme retains functions of a largely preventive nature (e.g., prenatal and postnatal care, family planning service delivery) in this category, whereas curative and rehabilitative functions (e.g., obstetric care, fistula treatment, and maternity care) are classified under respective categories HC.1 and HC.2.

The classification of RH activities in Appendix G provides a detailed elaboration and adaptation of the ICHA-HC by OECD. Next to including health-related functions, such as infrastructure development, health personnel training and research, it also includes the so-called Addendum or non-health related functions, such as legal support to people living with HIV/AIDS or reproductive health policy advocacy. For reasons of analysis and flexibility, it is advisable to maintain this level of detail, even though for practical purposes information can be presented at a more aggregated level. Since it may not always be possible to collect data on all of the categories, in practice the number can be limited to those categories that are relevant and feasible.

Countries that implement an RHA may also want to expand or adapt the functional classification to their specific needs, possibilities and circumstances. For instance, it may be relevant to append categories for services that fall outside the allopathic system – for example, Ayurvedic or homeopathic alternatives – and cannot be assigned to the present classification.

Viewing activities in relation to the objectives they serve provides a good basis for the monitoring and evaluation of the activities, and the formulation of a set of indicators to measure the performance of the activities. Monitoring and evaluation regard reproductive health programmes as composed of a set of activities that use (invest) inputs or resources (financial, manpower, technology) and that produce results (output) at the programme level intended to lead to changes at the population level (outcome) (Bertrand and Tsui, 1995: 15).

The expenditures

The flow of funds from source to final use (recipient, beneficiary) usually passes through several channels. Different data collection instruments are required to capture this flow at different points. Donor surveys collect expenditure data from financing sources. Provider surveys collect information from providers of health care on funds received (income) and money spent. They may also include information on services delivered, visitors, etc. For the same transactions, provider data may differ from data produced by financing agents or donors.

WHO (2003:112) recommends starting the measurement of expenditures with financing agents, then working upstream to financing sources and downstream to providers and activities or functions. A particularly difficult issue is to determine in sufficient detail how much is spent on the various RH activities. It is often not possible to determine what funds are allocated to specific activities because the

activities are not listed in sufficient detail. This is particularly true in the case of a sector-wide approach (SWAp).

The passage of funds through multiple channels of assistance before reaching the final beneficiary takes time. Generally, funds committed or allotted at one point in time are spent some time later. To accommodate these differences, accounting distinguishes between cash accounting and accrual accounting (see Section 3.1.2). Thus the RF project distinguishes between primary funds and final expenditures. Primary funds provided by a primary donor to an intermediate donor in year A may be spent by the intermediate donor in year B. Funds allotted in year A but spent in year B would be included under primary funds in year A and final expenditures in year B. The RF project also requests primary donors to report future commitments. These figures are used to generate real-time estimates for donor assistance in the area of population and AIDS activities.

WHO makes a distinction between three types of spending elaborated as follows: Anticipated spending which comprises reported future commitments for RH activities? Such commitments or budgetary estimates of expenditures may never materialise, or may be subject to overruns or under-runs; Executed spending, here: data on executed spending are more solid than budget estimates. They may be subject to revision, however, when later data become available; and, Audited spending: audited accounts of actual spending are the most reliable. A drawback is the delay in data availability. Data on audited expenditures become available one to two years after the actual expenditures. As a result, provisional estimates or unaudited data are used until the more reliable audited data become available (WHO, 2003: 84).

Constructing an RHA in Africa: A Framework and an Example

On the basis of our search for literature in NHA and RH studies including costing of RH as well as estimation of RHA, we suggest a framework that considers three groups of issues: methodological issues, implementation issues and the way forward. We then provide an indicative empirical HA estimation and interpretation example.

Methodological Issues

The methodological issues considered in this framework relate to: definitional issues, boundary issues and measurement issues. Management of the estimation process, including institutionalisation, also requires focus here, as do data sources and analysis.

Definitional issues

Issues relating to the type of resource-tracking questions to be addressed in constructing RHA are considered a major definitional issue that should be addressed by all countries constructing the RHA. Among such questions to be

addressed are: how are funds mobilised and managed; how do public sources and private sources compare; are funds adequate for covering the expenses of activities required to achieve target RH levels; who provides goods and services and what resources do they use; who pays and how much is paid for RH care; how are funds distributed among different activities and inputs; and, who benefits from RH expenditure?

With respect to what constitutes RH expenditure, the standard definition from the NHA Manual as adapted for RH, is any spending whose primary purpose is to restore, improve and maintain reproductive health of the individual and the population.

However, definitional issues are not as clear-cut in RH as in HA. For example, the ICPD adaptation of the WHO definition of health for RH is problematic from the point of view of health economics. Hurley (2000) argued that one drawback to the WHO definition is that it conflates health and utility. This is because, strictly interpreted, the WHO definition will include safety interventions like crash barrier whose primary purpose is to reduce accidents, even though such are not conventionally considered as health care. It will be preferred to have a definition of health that emphasises physical and mental functions rather than only those encompassing purely physiological functions. Health care should therefore be demanded and consumed to ensure that people can restore, improve and maintain health (or at least prevent its deterioration). Our framework recommends that only the activities of RH that conform to this view be considered in the RHA construction.

Boundary issues

The boundary issues to be considered are:

Activity boundary: Clear agreement is necessary on the overlap and cut-off between MCH and RH. The cut-off suggested in our review is adopted; while there is overlap mainly on safe motherhood, with child health, the cut-off should be the point at which child care has influence on mother's RH and vice versa. Thus, breastfeeding and postnatal HIV mother to child transmission (MTCT) is RH while expanded programme on immunisation (EPI) or vaccination of under-fives is not.

Space boundary: The entire country is the space boundary for each group participating in the study.

Time boundary: There are two types of time boundaries. The first is the estimation period, which is one year. However, for expenditure the accrual method is recommended, i.e., expenditure is recorded for the period when the activity takes place rather than the cash accounting method through which expenditure is registered when payment is made.

Measurement issues

Measurement of RH expenditures must satisfy the following criteria:

Transparency, the data sources, classifications and definitions used should be clearly documented, including any adjustments and calculations; Policy relevance, only RH issues relevant to the specific country's policy development will be included; Comparability, the RHA being constructed should be comparable with international standard classifications and definitions. (Where there are departures they should be documented.); and, Measurement feasibility, It should be feasible to compile and validate RHA data within reasonable time (usually within a year) and cost.

Management of the estimation process

The stakeholders and actors that should be addressed in the estimation of RHA are financing sources (FS), financing agents (FA), providers (P) and beneficiaries. It is proposed to have as a minimum, demographic attributes such as age, gender, race or ethnicity, and place of residence in defining the beneficiaries.

In general, the construction of RHA, as a satellite account of NHA, should be country-owned and government-led, even when the estimating is not directly by a government agency. This has the advantage of making the findings more likely to be used in policy making, because it will more likely command acceptability. To achieve this, two bodies should be established to manage the RHA estimation process:

Steering committee (SC) consisting of policy-makers from the public and private sectors as well as the donor community, chaired by the Minister of Health or the minister's nominee. This gives overall guidance to the process and confers credibility and acceptability; and

Technical committee (TC) consisting of members of the estimation team and persons knowledgeable in national economic statistics, accounting practices, health systems and policies, as well as data collection and analysis.

Another issue worth considering relates to where RHA estimation should be housed. Possible candidates are the MOH, MOF, ministry or department of national planning, or a university or national research institute.

Data sources and analysis

Data for the estimation of an RHA can be obtained from both secondary and primary sources. The types of data collected depend on the primary objectives of the sub-analysis (which are based upon the key policy questions identified by the steering committee), the existence of needed data and the feasibility of retrieving the data.

Data collection: The first step in organising the data collection process is to review and list all available data, or secondary data sources. Examples of secondary data include MOF-executed budgets, completed demographic and health surveys, living standard measurement and provider-based surveys, existing health information system data (typically collected by the MOH) on RH services and utilisation, and data retrieved from the USAID NEWVERN⁵ information system, which tracks contraceptive commodities provided by international donors. Once the secondary data has been collected, the team identifies gaps that need to be filled through primary data collection – the implementation of surveys. Because primary data collection is usually the most costly element of the NHA exercise, budgetary requirements for an RH subanalysis depend greatly on how much primary data collection is needed as in the case of household/facility survey.

Data analysis: As a minimum, we propose the following estimates must be obtained:

Total reproductive health expenditure (*TRHE*) aggregates reproductive health expenditure from public sources, i.e., government reproductive health expenditure (*GRHE*) and private outlays on reproductive health (*PRHE*), such that: $TRHE = GRHE + PRHE$

GRHE is made up of tax-funded reproductive health expenditure (*TFRHE*), reproductive health expenditure covered by social security/health insurance (*SIRHE*) and external resources funded reproductive health expenditure (*ERRHE*), such that: $GRHE = TFRHE + SIRHE + ERRHE$

TFRHE is the expenditure portion of public outlays by the territorial governments, whether central, federal, provincial, regional, state, district, municipal or local, for interventions in reproductive health care services.

SIRHE is the proportion of total premium paid by employees and employers for compulsory schemes of health (medical) care and medical goods channelled to reproductive health care for a sizeable group of population.

ERRHE represents reproductive health development channelled through the Ministry of Health or other public agencies. Grants in-kind refer to capital equipment, pharmaceutical supplies and vaccines, and technical assistance such as experts.

PRHE integrate private health insurance (*PHI*) and other prepaid schemes, mandated enterprise health expenditure (*MEHE*), expenditure on health through non-profit health services (*NHE*) and direct payments or out-of-pocket expenditure (*OOP*) on health goods including co-payment as well as direct disbursements by uninsured individuals. Accounts not captured by the other headings, including private investment in reproductive health services (*PIRH*), are also added. Therefore, $PRHE = PHI + MEHE + NHE + OOP + \text{other (including } PIRH)$.

Private health insurance expenditure (*PHIE*) is the total of premiums collected from employers, households and sometimes other agents to prepay reproductive health

related medical and paramedical benefits, including the operating costs of these schemes.

Out-of-pocket expenditure (*OOP*) is the direct outlay of households, including gratuities and payments in-kind made to reproductive health practitioners and suppliers of pharmaceuticals, therapeutic appliances, and other goods and services whose primary intent is to contribute to the enhancement of the reproductive health status of individuals or population groups.

Implementation Issues

In implementing the framework, it is recommended that the proposed RHA construction in Africa should learn from the experiences of countries that have done such estimation, such as Egypt and Rwanda. Besides, the estimation should be in phases:

Phase I should involve countries with NHA experiences so we can benefit from the economies of scale of their existing NHA infrastructure. These include seven countries in the East and Southern Africa NHA estimation network (Naboyonga and Munguti, 2001) and Nigeria (Soyibo *et al.*, 2005).

Phase II will involve countries yet to estimate NHA. This will involve first developing their NHA estimation capacity and infrastructure before we can specialise into RHA and similar satellite accounts of the NHA.

We suggest the following six-step approach as a way forward in implementing this framework: Identify the countries that are now in Phase I; Design and organise training workshops on conceptual issues and methodologies, as well as country experiences in health accounts estimation in Africa and elsewhere and other relevant issues; Use the output of the training workshops as the basis for agreed approaches to be taken in constructing RHA in Africa to ensure comparability; Conduct RHA estimation in the different countries using a network approach; Disseminate results; and, Follow up with Phase II and other relevant activities.

An Empirical Example

The illustrated example provided here is for NHA estimation that, as demonstrated in the foregoing section, is similar in process and methodology to RHA. It therefore broadly indicates what needs to be done in RHA estimation in Africa. It uses indicatively the estimation of Nigeria's NHA for 1992–1995, with a view to demonstrating and highlighting the challenges confronting HA estimation in a third world environment can be overcome. Berman (1997) is the classic reference on the construction of an NHA and its satellite accounts like RHA. Others are Soyibo *et al.* (2005) and Naboyonga and Munguti (2001).

Estimation process management and methodology

The estimation process underwent a number of phases, including progressive capacity development of the Technical Team and changing funding sources.⁶ the process involved consultations with various stakeholders through consensus workshops across the country. In these workshops, stakeholders were sensitised to the concepts and uses of NHA as early as 1999, yet the process was not completed until 2004/05 as it took several years to secure additional funds for project completion. Once funds were secured, a Steering Committee, chaired by the Permanent Secretary of the Federal Ministry of Health was set up. The Technical Team was expanded to broaden its base and facilitate the capacity development of NHA estimation in Nigeria.

The identified data set needed for the study included household health expenditure, enterprise health expenditure, administrative (government) health expenditure, and spending by donors and development partners. Because of funding limitations, only data on enterprise, administration, and donors' and development partners' health expenditure could be collected. These were gathered through surveys using a representative sample of the socio-cultural groups of Nigeria. Before embarking on the data collection, sample NHA matrixes as expected outputs of the study were developed. These facilitated the development of the questionnaires used to collect the data. Administrative data was collected from federal, state and local government ministries and their agencies. In addition, data was collected from donor agencies and development partners as well as NGOs to determine their expenditure on health in Nigeria.

In all cases, data was collected for the five-year period 1998–2002. For household health expenditure, we did a partial analysis of the household health expenditure as contained in the General Household Survey (GHS) conducted by the Federal Office of Statistics (FOS) in 2002. The GHS had a question on health expenditure, but the questionnaire did not seek any information on provider choice. Our study, therefore, adapted the provider distribution of household health expenditure from the Benue State household expenditure survey of 2001 (Soyibo and Ladejobi, 2002) for the entire country and period of study. This is a big limitation of the study in that it assumes that Benue State is representative of the country. For example, as it is largely a rural state, households did not report any health expenditure through health insurance; neither were there reimbursements of health expenditure to households by firms and other employers.

Besides, using the estimated household health expenditure for 2002, for the entire study period, also assumes that, the basket of health goods and services consumed by households remained constant for the five years under study and that it is affected only by inflation and population, which are assumed to vary with time. Accordingly, the study used the 2002, health expenditure, to estimate health expenditure for the other four years covered in the study by deflating the 2002

estimate to respective year estimates using the consumer price index for each of the years and cumulating by population.

The data collected on the health expenditure of the Federal Government and its agencies were highly aggregative and could hardly be broken down into budget line items, functions and providers. This made it difficult to estimate NHA matrixes by functions and by providers in which Federal Government values were adequately disaggregated. The household health expenditure used was not disaggregated by location and income quintile or by providers. Accordingly, the study could not estimate NHA matrixes disaggregated by location and income quintiles.

Sample results and discussion

We present and discuss in this section two sample NHA matrixes for Nigeria for 1998 (Tables 6.3 and 6.4) and summary NHA trend data for Nigeria over 1998–2002. Total health expenditure (THE) in Nigeria in 1998 was ₦157.1 billion or 5.45 per cent of GDP. It was spent largely by households, whose expenditure of ₦108.7 billion was 69 per cent of THE. Total government health expenditure (TGHE) was 15 per cent of THE with the Federal Government contributing 10 per cent, States 4 per cent and local governments just 1 per cent. It is interesting that donors spent more than any of the tiers of government in 1998, contributing 13 per cent of THE.

Total private health expenditure (TPHE) was ₦113.0 billion or 3.92 per cent of GDP. In contrast, TGHE was just ₦23.5 billion or 0.82 per cent of GDP. Health expenditure by donors was ₦20.6 billion, which is 0.71 per cent of GDP. Among financing agents, private entities dominate in channelling funds to and/or paying providers of health services directly. Thus, out-of-pocket health expenditure by households, health insurance and NGOs together accounted for a total of ₦116.0 billion, which is 73.9 per cent of THE. This means that just a little over a quarter of THE was channelled through public entities in 1998. Health insurance expenditure of ₦2.8 billion was just 1.79 per cent of THE.

Table 6.3: 1998 NHA matrixes: Sources to financing agents

Providers	Financing agents						Total
	Federal government	State government	Local government	Firms	Households	Donors	
Federal ministries	15,199.00					5,096.00	30,295.00
State ministries		6,044.00				1,128.00	7,172.00
LGA health departments		118.13	2,141.00			1,335.00	3,594.13
Out of pocket				808.95			2,808.95
NGOs				1,499.09	108,720.00		110,219.10
Total						2,992.00	2,992.00

Source: Soyibo *et al.* (2005).

The characteristics and trend of Nigeria's NHA over the period 1998–2002 are indicated in Table 6.5. As a proportion of GDP, Nigeria's health expenditure varied between the least value of 4.39 per cent in 2000 and the highest value of 5.45 per cent in 1998, with an average THE/GDP ratio of 4.78 per cent. This does not compare favourably with the average THE/GDP ratio of 7.2 per cent for the Eastern and Southern Africa NHA Network (Naboyonga and Munguti, 2001). In fact, many less endowed countries of the subregion performed better than Nigeria in this respect. Among these are: Rwanda (5.0 per cent), Kenya (5.3 per cent), Zambia (6.2 per cent), Tanzania (6.8 per cent), Malawi (7.2 per cent) and South Africa (7.5 per cent).

Table 6.4: 1998 NHA matrix: Financing agents by providers

Providers	Financing agents						Total
	Federal mini-stries	State mini-stries	Health departments	Health insurance	Out-of-pocket	NGOs	
Government facilities		2,498.98	304.78		22,043.81		24,847.57
Private facilities				2,808.95	39,678.86		42,487.81
Mission/NGO facilities					15,430.67		15,430.67
Chemists/pharmacies					22,043.81		22,043.81
Traditional health care					6,613.15		6,613.15
Others	3,0295.00	4,673.02	3,289.35		4,408.76	2,992.00	4,5658.13

Source: Soyibo *et al.* (2005).

Nominally, Nigeria's THE was on an upward trend over the period 1998–2002. It grew by 14.52 per cent, from ₦157.1 billion in 1998 to ₦179.9 billion in 1999. Correspondingly, it grew by 19.63 per cent to ₦215.2 billion between 1999 and 2000. Growing by 19.09 per cent between 2000 and 2001, THE became ₦256.3 billion in 2001. Between 2001 and 2002 however, the growth rate of THE slowed significantly, to 8.76 per cent. The average simple growth rate over the period 1999–2002 is 15.5 per cent.

Table 6.5: Characteristics and trend of health expenditure in Nigeria

	1998	1999	2000	2001	2002
Total health expenditure (THE)	15,7081.1	179,891.20	215,209.13	256,283.42	278,732.15
General govt. exp	23,502.13	29,882.85	40,391.25	69,765.96	60,211.87
Federal	15,199.00	16,866.03	22,781.25	45,078.14	34,538.73
State	6,162.13	6,486.68	13,552.27	20,417.09	20,660.43
Local	2,141	6,530.14	4,057.73	4,270.73	5,012.71
Private expenditure	113,028	125,096.40	139,918.84	172,248.41	201,416.28

Firms	4,308	6,313.96	10,046.77	14,646.75	17,817.91
Household	108,720	118,782.40	129,872.07	157,601.66	183,598.37
Donors	20,551	24,911.96	34,899.04	14,269.05	17,104.00
GDP (million naira)	2,882,310	3,322,030	4,902,800	5,702,650	5,927,680
Population (thousands)	108,635	111,681	114,746	117,823	120,911
THE/GDP	5.45	5.42	4.39	4.49	4.70
Govt/THE	14.96	16.61	18.77	27.22	21.60
HHD/THE	69.21	66.03	60.35	61.50	65.87
Per capita THE	1,445.953	1,445.95	1,655.92	1,981.03	2,359.12

Source: Soyibo *et al.* (2005).

Concluding Remarks

This chapter provided a detailed review of the literature of HA, including NHA and its satellite accounts on HIV/AIDS, immunisation and RH. It also looked into issues of concepts and definitions relating to RH; the empirical literature on costing in RH; and estimation issues in RHA. Using this review, we highlighted issues of critical importance to the construction of an RHA in Africa and designed a framework for doing so. The chapter also presented an illustrative example of an NHA estimation experience from Nigeria that included discussion and interpretation of results.

For ease of implementation, we adopted a utilitarian approach. Accordingly, we have attached a number of annexes containing classification schemes relevant to RHA estimation as well as approaches used by selected researchers in RH costing studies, to facilitate user- referencing. Although there are some examples of NHA estimation in a number of African countries, the countries that have estimated one of its satellite accounts, the RHA, are very few and far between. This chapter, it is hoped, can serve as a wake-up call to doing this.

The framework it sets out can be used to promote the development of a network of countries to do this. This will, at the least, make the countries of the network benefit from the synergy and economies of scale derivable from networks in implementing this important policy tool that can help them inch closer to achieving the fifth MDG targeted at reducing maternal mortality, with the facilitation of the provision of information on financial resource availability for RH. Of course, RHA cannot achieve the fifth MDG alone. Its availability can, however, be used to monitor the stewardship role of government, vis-à-vis other sources in the provision of financial resources for RH, and hence assess, in part, the extent to which government is committed to promoting the achievement of the fifth MDG. This is because, it can ginger governments and other stakeholders to do better and perhaps lead to the lightening of the burden borne by any identified marginalised stakeholder in the funding of RHA in Africa.

Notes

1. The expenditure referred to here is actual expenditure. It is not budget allocation or unspent budget release, neither is it the implicit cost of health care, which includes opportunity cost.
2. A Ministry of Education expenditure on school feeding whose primary objective is to encourage students to stay in school is a non-health expenditure. But if the primary objective of the programme is to improve nutrition and hence the health of students, then by definition it is health expenditure. If the programme has dual objectives, one of them must be primary and the other secondary.
3. Sections 3.2 and 3.3 borrow substantially from PHR plus (2002).
4. The system of national accounts (SNA) is a broad structure for national economic accounting developed jointly by the Commission of the European Communities, the International Monetary Fund, the OECD, the United Nations, and the World Bank. The rules and structure of the SNA are contained in a manual called *System of National Accounts 1993* (United Nations, 1993), typically abbreviated SNA93.
5. The custom-designed database for USAID, NEWVERN, is a notable case of a central information system that works. In operation since the 1980s, NEWVERN can quickly generate responses to requests for information that are frequent and varied. USAID Missions, USAID/Washington, UNFPA, cooperating agencies, field programmes, auditors and researchers, among others, look to NEWVERN for answers to their questions about condoms and contraceptive shipments and funding.
6. For example, the members of the technical team, consisting of academics from the Universities of Ibadan and Benin, as well as staff of the then Federal Office of Statistics, now National Bureau of Statistics, attended a number of training workshops in Nigeria sponsored by the Carnegie Corporation, which gave the initial grant for the project. This grant was administered by the then International Health Policy Program, an activity of the Pew Charitable Trust, World Bank and WHO, based in Washington, D.C. The completion grant was provided by WHO, Geneva, and was administered by its country office in Nigeria. Ideally, the process should be completed within a year; however, a lack of funds caused Nigeria's effort to span several years.

References

- Abel-Smith, B. 1963. *Paying for Health Services: A Study of the Costs and Sources of Finance in Six Countries*. Public Health Paper #17. World Health Organisation, Geneva.
- Aitken, Iain and Laura Reichenbach. 1994. "Reproductive and sexual health services: Expanding access and enhancing quality". In G. Sen, A. Germain, and L.C. Chen, eds., *Population Policies Reconsidered: Health Empowerment, and Rights*. Boston: Harvard School of Public Health.

- Barnett, C., M. Bhawalkar, A.K. Nandakumar and P. Schneider 2001. *The Application of the National Health Accounts Framework to HIV/AIDS in Rwanda*. Abt Associates, Bethesda, Maryland.
- Berman, P.A. 1997. "National health accounts in developing countries: Appropriate methods and recent applications". *Health Economics*, 6: 11–30.
- Bernard, J. and A. Tsui. 1995. "Indicators for reproductive health program evaluation". Carolina Population Center, University of North Carolina, Chapel Hill.
- Borghuis-Lub, T.L., M. de Bruine and R.M. Lapré. 1994. *Gezondheidszorg geordend. Een kwartet scenario's Health care ordered. Four scenarios*. Institute Policy and Management Health Care, Erasmus University, Rotterdam (in Dutch).
- Claeys, V. and E. Wuyts. 2004. "Official development assistance levels and spending for sexual and reproductive health and rights since the ICPD". Background paper for the European Population Forum 2004, Geneva, January.
- Conly, S. and S. de Silva. 1998. *Paying Their Fair Share? Donor Countries and International Population Assistance*. Population Action International, Washington, D.C.
- Conly, S.R., N. Chaya and K. Helsing. 1995. *Family Planning Expenditures in 79 Countries: A Current Assessment*. Population Action International, Washington, D.C.
- De, S. *et al.* 2004a. "Application of the National Health Accounts HIV/AIDS subanalysis to the Resources Flows Project". Prepared for UNFPA/UNAIDS/NIDI Resource Flows project. Abt Associates, Bethesda, Maryland.
- De, S. *et al.* 2004b. "Measurement of population expenditures at the subnational level using the National Health Accounts framework". Prepared for UNFPA/UNAIDS/NIDI Resources Flow project. Abt Associates, Bethesda, Maryland.
- Demery, L. 2000. "Benefit incidence: A practitioner's guide". Mimeo. Poverty and Social Development Group, the World Bank, Washington, D.C.
- DFID. 2000. *National Health Accounts: What Are They and How Can We Use Them?* Briefing Paper. Department for International Development, UK.
- Eiseman, D. and D. Fossum. 2005. *The Challenges of Creating a Global Resource Tracking System*. RA441.E375 2005. Rand Corporation, Santa Monica, California. Sponsored by the Global Health Policy Research Network, a program of the Center for Global Development, sponsored by the Bill & Melinda Gates Foundation and conducted by Rand Health, a division of the Rand Corporation.
- Elias, C. and J. Sherris. 2003. "Reproductive and sexual health of older women in developing countries. Women and their healthcare providers face unique needs and challenges". *British Medical Journal*, 327: 64–5.
- Ethelston, S., A. Bechtel, N. Chaya, A. Kantner and C.G. Vogel. 2004. "Progress and promises: Trends in international assistance for reproductive health and population". Population Action International, Washington, D.C. Available from <http://www.populationaction.org/resources/publications/pandp/index.php?static=summary>.

- Global Health Resource Tracking Working Group. 2005. *Following the Money in Global Health. Recommendations for Global Health Resource Tracking*. Executive Summary. Center for Global Development, Washington, D.C.
- Government of Madhya Pradesh. No date (n.d.). *State Health Policy of Madhya Pradesh*. <http://www.mp.nic.in/health/healthpolicy.HTM> Accessed 30 July 2004.
- Gribble, J.N., V. Jennings and M. Nikula, 2004. "Mind the gap: Responding to the global funding crisis in family planning". *The Journal of Family Planning and Reproductive Health Care*, 30 (3): 155–57.
- Griffiths, A., and Mills. 1982. *Money for Health: A Manual for Surveys in Developing Countries*. Third World Series No. 3. Sandoz Institute for Health and Socio-Economic Studies, Geneva, Switzerland.
- Griffiths, A. and A. Mills. 1983. "Health sector financing and expenditure surveys". In K. Lee and A. Mills, eds., *The Economics of Health in Developing Countries*, pp. 43–63. Oxford: Oxford University Press.
- Hurley, J. 2000. "The normative economics of health and health care". In A.J. Culyer and J.P. Newhouse, eds, *Handbook of Health Economics*, pp. 56–118. Amsterdam: North Holland.
- ICPD. 1994. ICPD Programme of Action. International Conference on Population and Development, Cairo. Available at http://www.unfpa.org/icpd/icpd_poa.htm.
- Sharma, S., W. McGreevy and D. Hotchkiss. 2000. "Financing reproductive and child health in Rajasthan: The sources and uses of funds". Indian Institute for Health Management Research (IIHMR) in Jaipur, India, and the Futures Group International (FGI), Washington, D.C.
- IPS. 2004. "Review of costs and financing of reproductive health services". Report prepared for the World Bank's South Asia Health, Nutrition and Population Unit. Institute of Policy Studies (IPS) of Sri Lanka, Health Policy Programme, Colombo, Sri Lanka.
- Janowitz, Barbara. 1993. "Why do projections of the cost of family planning differ so widely?" *Studies in Family Planning*, 24 (1): 62–5.
- Janowitz, B., J.H. Bratt. 1992. "Cost of family planning services: A critique of the literature". *International Family Planning Perspectives*, 18 (4, Dec): 137–44.
- Kates, J. 2005. "Financing the response to HIV/AIDS in low and middle income countries: Funding for HIV/AIDS from the G7 and the European Commission". The Henry J. Kaiser Family Foundation, Menlo Park, California.
- Knowles, J.C. and J. Behrman. 2000. "Case study: Benefit incidence of safe motherhood services in Vietnam". Reading material. UNFPA staff course, "Adapting to Change", Turin, Italy, 28 October–1 November 2002. Available at <http://www.reprohealth.org/unfpa> Accessed 30 July 2004.
- Mamotlohi Alina Mohanoe. 2004. "Public spending and health status in Lesotho". Paper presented at the Ninth Annual Conference on Econometric Modelling for Africa, 30 June–3 July 2004, Cape Town, South Africa. Available at <http://www.commerce.uct.ac.za/economics/AES2004Conference/Papers/Mamotlohi%20final.pdf> Accessed 30 July 2004.

- Mach, E.P. and B. Abel-Smith. 1983. *Planning the Finances of the Health Sector: A Manual for Developing Countries*. Geneva: World Health Organisation.
- Matheny, G. 2004. "Family planning programs: Getting the most for the money". *International Family Planning Perspectives*, 30 (3): 134–38.
- McKellar, L. 2005. "Priorities in global assistance for health, AIDS, and population". *Population and Development Review*, 32 (2): 293–312.
- Meerman, J. 1979. *Public Expenditure in Malaysia: Who Benefits and Why*. New York: Oxford University Press.
- Murray C.J.L. and A.D. Lopez, eds. 1996. *The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries, and Risk Factors in 1990 and Projected to 2020*. Cambridge, Massachusetts: Harvard University Press.
- Naboyonga, Juliet and Nzoya Munguti. 2001. "National health accounts in Eastern and Southern African Countries: A comparative analysis". Mimeo. University of Cape Town, South Africa.
- Nandakumar, A.K., M. Bhawalkar, M. Tien, R. Ramos and S. De. 2004. *Synthesis of Findings from NHA Studies in Twenty-Six Countries*. Bethesda, Maryland: Abt Associates.
- Odumosu, O., A. Soyibo and A. Mahal. 2002. "Plan of action for the HIV/AIDS accounts for Nigeria". Ibadan: AIDS Prevention Initiative in Nigeria and Nigerian Institute of Social and Economic Research.
- OECD. 1997. *A System of Health Accounts for International Data Collection*. Paris: Organisation for Economic Cooperation and Development.
- OECD. 1998. *OECD Health Data 98*. Software. Organisation for Economic Cooperation and Development, Paris.
- OECD. 2000. *A System of Health Accounts*. Paris: Organisation for Economic Cooperation and Development.
- Padmadas, S., I. Hutter and F. Willekens. 2004. "Does cesarean section trigger postpartum sterilisation?" Accepted *International Journal of Gynaecology and Obstetrics*.
- Pass, C., B. Lowes, L. Davies *et al.* 1991. *The Harper Collins Dictionary of Economics*. New York: Harper.
- PHRplus. 2002. "Using NHA to inform the policy process". Partners for Health Reform Plus Project, funded by the United States Agency for International Development (USAID). Abt Associates, Bethesda, Maryland. <http://www.phrplus.org/Pubs/sp3.pdf>.
- PHRplus 2003. *Understanding NHA: The Methodology and Implementation Process – Primer for Policy Makers*. Bethesda, Maryland: Abt Associates. Funded by the United States Agency for International Development (USAID).
- Potts, M., J. Walsh, J. McAninch, N. Mizoguchi and T.J. Wade. 1999. "Paying for reproductive health care: What is needed, and what is available?" *International Family Planning Perspectives*, 25 (supplement): S10–S16.

- Rannan-Eliya, R.P., P. Berman, E.E. Eltigani, I. de Silva, A. Somanathan and V. Sumathiratne. 2000. *Expenditures for Reproductive Health and Family Planning Services in Egypt and Sri Lanka*. The POLICY Project, Futures Group International, Inc., Washington, D.C. Funded by the United States Agency for International Development (USAID).
- Robertson, R.L., D.K. Zschock and J.A. Daly. 1979. *Guidelines for Analysis of Health Sector Financing in Developing Countries*. United States Department of Health, Education and Welfare, Bethesda, Maryland.
- Sanderson, W.C. and J-P. Tan. 1995. *Population in Asia*. World Bank Regional and Sectoral Studies. The World Bank, Washington, D.C.
- Selowsky, M. 1979. *Who Benefits from Government Expenditure? A Case Study of Colombia*. New York: Oxford University Press.
- Sharma, S., W. McGreevey, B. Kanjilal and R. Hotchkiss. 2002. "Reproductive and child health accounts: An application to Rajasthan". *Health Policy and Planning*, 17 (3): 314–21.
- SIDALAC. 2001. *National HIV/AIDS Accounts. National Estimation of Financial Flows and Expenditures on HIV/AIDS*. Technical handbook for estimating the national health accounts on HIV/AIDS. SIDALAC, Mexico, DF. Available at <http://www.sidalac.org.mx/english/publications/naccounts/guide.pdf#search='sidalac%20national%20estimation'>. Accessed 23 December 2004.
- Singh, S., J.E. Darroch, M. Vlassoff and J. Nadeau. 2004. *Adding It Up: The Benefits of Investing in Sexual and Reproductive Health Care*. Washington, D.C. and New York: The Alan Guttmacher Institute and UNFPA.
- Soyibo, A and Foluso Ladejobi. 2002. *Estimating Household Health Expenditure in Benue State of Nigeria*, Report Submitted to the Benue State Health Fund/The United Kingdom Department for International Development.
- Soyibo, A., O. Odunosu, F. Ladejobi, A.O. Lawanson, B. Oladejo and S. Alayande. 2005. *National Health Accounts of Nigeria: 1998–2002*. Report submitted to the World Health Organisation, Geneva.
- Standing, H. 2002. "Towards equitable financing strategies for reproductive health. Alternative ways to finance reproductive health care". IDS Working Paper 153. Institute of Development Studies, Sussex. <http://www.eldis.org/static/DOC9743.htm>.
- UNAIDS. 2004. *National Spending for HIV/AIDS 2004*. Geneva: Joint United Nations Programme on HIV/AIDS.
- UNAIDS. 2007. *AIDS Epidemic Update: December 2007*. Geneva: Joint United Nations Programme on HIV/AIDS.
- UNFPA 2002. *Financial Resource Flows for Population Activities in 2000*. Publication E/1200/2002. United Nations Population Fund (UNFPA), New York.
- United Nations. 1993. *System of National Accounts, 1993*. New York: United Nations.

- United Nations. 1994. *Report of the International Conference on Population and Development, Cairo 1994*. United Nations A/conf 171/13. New York: United Nations.
- Van Dalen, H.P. and M. Reuser. 2005. *What Drives Donor Funding in Population Assistance Programs?* Discussion Paper No. TI 2005-062/1. Tinbergen Institute, Amsterdam. Available at <http://www.nidi.knaw.nl/en/staff/vandalen/>.
- Van de Walle, D. 1995. "Public spending and the poor: What we know, what we need to know". Policy Research Working Paper Series No. 1476. The World Bank, Washington, D.C.
- WHO. 1995a. *Communicating Family Planning in Reproductive Health: Key Messages for Communicators*. WHO/FRH/FPP/97.33. Geneva: World Health Organisation.
- WHO. 2003. *Guide to Producing National Health Accounts. With Special Applications for Low-Income and Middle-Income Countries*. Geneva World Health Organisation. Available at <http://whqlibdoc.who.int/publications/2003/9241546077.pdf>.
- WHO. 2004. *Unsafe Abortion: Global and Regional Estimates of Unsafe Abortion and Associated Mortality in 2000*, 4th Edition. Geneva: World Health Organisation.
- Wouters, A., S. Bennett and C. Leighton. 1998. *Alternative Provider Payment Methods: Incentives for Improving Health Care Delivery. PHR Primer for Policymakers*. Partnerships for Health Reform. Abt Associates, Bethesda, Maryland.
- Zeitlin, J., R. Govindaraj and L.C. Chen. 1994. "Financing reproductive and sexual health services". In G. Sen, A. Germain and L.C. Chen, eds., *Population Policies Reconsidered: Health Empowerment, and Rights*. Boston: Harvard School of Public Health.

Appendix

A: *WHO Classifications*

Table 6.A1: WHO classification of financing sources

Code	Description
FS.1	Public funds
FS.1.1	Territorial government funds
FS.1.1.1	Central government revenue
FS.1.1.2	Regional and municipal government revenue
FS.1.2	Other public funds
FS.1.2.1	Return on assets held by a public entity
FS.1.2.2	Other
FS.2	Private funds
FS.2.1	Employer funds
FS.2.2	Household funds
FS.2.3	Non-profit institutions serving individuals
FS.2.4	Other private funds
FS.2.4.1	Return on assets held by a private entity
FS.2.4.2	Other
FS.3	Rest of the world funds

Source: WHO (2003: 42).

Table 6.A2: OECD classification of financing agents

ICHA-HF code	HF code description
HF.1	General government
HF.1.1	Territorial government
HF.1.1.1	Central government
HF.1.1.2	State/provincial government
HF.1.1.3	Local/municipal government
HF.1.2	Social security funds
HF.2	Private sector
HF.2.1	Private social insurance
HF.2.2	Other private insurance
HF.2.3	Private households' out-of-pocket payment
HF.2.4	Non-profit institutions serving households (other than social insurance)
HF.2.5	Private firms and corporations (other than health insurance)
HF.3	Rest of the world

Source: WHO (2003: 36).

Table 6.A3: Classification scheme for providers

Code	Description
HP.1	Hospitals
HP.1.1	General hospitals
HP.1.2	Mental health and substance abuse hospitals
HP.1.3	Specialty (other than mental health and substance abuse) hospitals
HP.1.4	Hospitals of non- allopathic systems of medicine
HP.2	Nursing and residential care facilities
HP.2.1	Nursing care facilities
HP.2.2	Residential mental retardation, mental health and substance abuse facilities
HP.2.3	Community care facilities for the elderly
HP.2.9	All other residential care facilities
HP.3	Providers of ambulatory health care
HP.3.1	Offices of physicians
HP.3.2	Offices of dentists
HP.3.3	Offices of other health practitioners
HP.3.4	Outpatient care centres
HP.3.4.1	Family planning centres
HP.3.4.2	Outpatient mental health and substance abuse centres
HP.3.4.3	Free-standing ambulatory surgery centres
HP.3.4.4	Dialysis care centres
HP.3.4.5	All other outpatient multi-specialty and cooperative service centres
HP.3.4.9	All other outpatient community and other integrated care centres
HP.3.5	Medical and diagnostic laboratories
HP.3.6	Providers of home health care services
HP.3.9	Other providers of ambulatory health care
HP.3.9.1	Ambulance services
HP.3.9.2	Blood and organ banks
HP.3.9.3	Alternative or traditional practitioners
HP.3.9.9	All other ambulatory health care services
HP.4	Retail sale and other providers of medical goods
HP.4.1	Dispensing chemists
HP.4.2	Retail sale and other suppliers of optical glasses and other vision products
HP.4.3	Retail sale and other suppliers of hearing aids
HP.4.4	Retail sale and other suppliers of medical appliances (other than optical glasses and hearing aids)
HP.4.9	All other miscellaneous sale and other suppliers of pharmaceuticals and medical goods
HP.5	Provision and administration of public health programmes
HP.6	General health administration and insurance
HP.6.1	Government administration of health
HP.6.2	Social security funds
HP.6.3	Other social insurance
HP.6.4	Other (private) insurance
HP.6.9	All other providers of health administration
HP.7	All other industries (rest of the economy)
HP.7.1	Establishments as providers of occupational health care services
HP.7.2	Private households as providers of home care
HP.7.3	All other industries as secondary producers of health care
HP.8	Institutions providing health-related services
HP.8.1	Research institutions
HP.8.2	Education and training institutions
HP.8.3	Other institutions providing health-related services
HP.9	Rest of the world
HP.nsk	Provider not specified by kind

Source: WHO (2003: 39–40).

Table 6.A4: WHO's global burden of disease classification scheme

Code	Description
GBD.1	Communicable diseases, maternal and perinatal conditions and nutritional deficiencies
GBD.1.1	Infectious and parasitic diseases
GBD.1.1.1	Tuberculosis
GBD.1.1.2	Sexually transmitted diseases
GBD.1.1.3	HIV disease
GBD.1.1.4	Diarrhoeal diseases
GBD.1.1.5	Childhood diseases
GBD.1.1.6	Meningitis
GBD.1.1.7	Hepatitis
GBD.1.1.8	Malaria
GBD.1.1.9	Tropical diseases
GBD.1.1.10	Leprosy
GBD.1.1.11	Dengue
GBD.1.1.12	Japanese encephalitis
GBD.1.1.13	Trachoma
GBD.1.1.14	Intestinal nematode infection
GBD.1.1.15	Respiratory infections
GBD.1.1.16	Maternal conditions
GBD.1.1.17	Perinatal conditions
GBD.1.1.18	Nutritional deficiencies
GBD.1.1.19	All other communicable, maternal, perinatal, and nutritional conditions
GBD.2	Noncommunicable conditions
GBD.2.1	Malignant neoplasms
GBD.2.2	Other neoplasms
GBD.2.3	Diabetes mellitus
GBD.2.4	Endocrinal and nutritional disorders
GBD.2.5	Neuropsychiatric disorders
GBD.2.6	Sense organ disorders
GBD.2.7	Cardiovascular diseases
GBD.2.8	Respiratory diseases
GBD.2.9	Digestive diseases
GBD.2.10	Diseases of the genitourinary system
GBD.2.11	Skin diseases
GBD.2.12	Muskuloskeletal diseases
GBD.2.13	Congenital abnormalities
GBD.2.14	Oral diseases
GBD.2.15	All other noncommunicable conditions
GBD.3	Injuries
GBD.3.1	Unintentional
GBD.3.1.1	Road traffic accidents
GBD.3.2	Intentional
GBD.3.2.1	Self-inflicted
GBD.3.2.2	Homicide and violence
GBD.3.2.3	War
GBD.3.3	All other injury conditions

Source: WHO (2003: 46).

B: Donors Included in the UNFPA/UNAIDS/NIDI Resource Flows Project (2004 Survey Round)

OECD/DAC Countries	
Australian Agency for International Development	Australia
Canadian International Development Agency	Canada
Danish Ministry of Foreign Affairs	Denmark
Department for International Development	United Kingdom
Direction du Développement et de la Coopération Technique	France
Directorate General for International Cooperation	Belgium
Europe Aid Coordination Office	European Union
Federal Ministry for Economic Cooperation and Development	Germany
Federal Ministry of Foreign Affairs	Austria
Hellenic Republic, Ministry of Foreign Affairs	Greece
Ministère des Affaires Etrangères	Luxembourg
Ministry of Foreign Affairs, Department for Development Policy	Finland
Ministry of Foreign Affairs of Japan	Japan
Ministry of Foreign Affairs, Development Cooperation Division	Ireland
Ministry of Foreign Affairs, Directorate General for Development Cooperation	Italy
Ministry of Foreign Affairs, Spanish Agency for International Development	Spain
Ministry of Foreign Affairs, Institute for Portuguese Cooperation	Portugal
Netherlands Ministry of Foreign Affairs, Directorate General for International Cooperation	The Netherlands
New Zealand's International AID and Development Agency	New Zealand
Norwegian Agency for Development Cooperation	Norway
Swedish International Development Cooperation Agency	Sweden
Swiss Agency for Development and Cooperation	Switzerland
United States Agency for International Development	United States
United Nations Organisations	
Food and Agriculture Organisation of the United Nations	
Global Fund to Fight AIDS, Tuberculosis and Malaria	
International Labour Organisation	
Joint United Nations Programme on HIV/AIDS	
United Nations Children's Fund	
United Nations Department of Economic and Social Affairs	
United Nations Development Fund for Women	
United Nations Development Programme	
United Nations Educational, Scientific and Cultural Organisation	
United Nations High Commissioner for Refugees	
United Nations Office on Drugs and Crime	
United Nations Population Fund	
United Nations Volunteers	
World Food Programme	
World Health Organisation	

Banks

World Bank

Asian Development Bank

African Development Bank

Inter-American Development Bank

International Foundations

Bill & Melinda Gates Foundation

Bristol-Myers Squibb Foundation

Clinton Foundation

Edith Stein Foundation

Fogarty International Center

Ford Foundation

Henry J. Kaiser Family Foundation

MacArthur Foundation

Population Area

OPEC Fund for International Development

Packard Foundation

Rockefeller Foundation

Safe Blood for Africa Foundation

Safe Blood for China Foundation

Summa Foundation

The Coca Cola Africa Foundation

The William and Flora Hewlett Foundation

United Nations Foundation

Wallace Global Fund

Welcome Trust

International NGOs

Engender Health Inc.

International HIV/AIDS Alliance

International Planned Parenthood Federation (IPPF)

International Projects Assistance Services (IPAS)

Japanese Organisation for International Cooperation in Family Planning (JOICP)

Johns Hopkins Program for International Education in Gynaecology and Obstetrics (JHPIEGO) Corporation

John Snow, Incorporated (JSI)

Marie Stopes International (MSI)

ORC Macro

Pathfinder International

Population Council

Population Services International (PSI)

Program for Appropriate Technology in Health (PATH)

C: *Selected Classifications of Reproductive Health and AIDS Activities*

Bernard and Tsui (1995) consider five broad categories that are also related to objectives:

- Safe pregnancy
 - Maternal and neonatal health
 - Post-abortion care
- STD/HIV
- Women's nutrition
- Breastfeeding
- Adolescent's reproductive health services

The categories include a range of activities. Viewing activities in relation to the objectives they serve provides a good basis for the monitoring/evaluation of the activities and the formulation of a set of indicators to measure the performance of the activities.

Rannan-Eliya et al. (2000) define the package of reproductive health services as consisting of:

- *Family planning services:* All programmes, goods and services intended to assist women to control their fertility, and all counselling, health education and information in support of the same.
- *Maternal health services:* All special programmes designed to provide antenatal and postnatal care to mothers, including provision of dietary supplements such as iron and vitamins for malnourished pregnant and lactating mothers.
- *Childbirth services:* Services to provide medical care for women delivering and giving birth.
- *Infant care:* All services intended to promote and improve the health and development of infants (defined as children aged less than 1 year), including baby health care, growth monitoring and growth promotion, and provision of dietary supplements such as micronutrients.
- *Other personal reproductive health services for women:* All other clinical services for women that intend to enable women to safely exercise their reproductive health functions, to be implemented as the equivalent of all obstetric and gynaecological services.

For the purpose of their study, *Rannan-Eliya et al.* did not include services intended to treat sexually transmitted diseases. The reason for excluding such services is not substantive in nature, but is related to data limitation.

Other classifications are related more to the expenditures or the use of funds. The organisation Abt Associates distinguishes between direct health care (HC) expenditures and indirect expenditures or health-related spending (see for example, *De et al., 2004b*). The indirect or health-related (HRC) expenditures are for activities that may overlap with other areas of the NHA:

- Mitigation activities, such as
 - Nutritional support for pregnant women
 - Caring for children orphaned by AIDS
 - Empowerment and human rights issues related to reproductive health and HIV/AIDS (*Odumosu et al., 2002:7*)
- Training and supportive services, such as
 - Education and training of health personnel
 - Operational research and development

- Capital formation to providers, such as
 - Lab facilities
 - Drug supply and storage systems

The Indian Institute for Health Management Research and the POLICY Project of Futures Group International (Sharma *et al.*, 2000) distinguishes activities based on the use of funds:

- Antenatal care
- Childbirth
- Postnatal care
- Family planning
- Child health care
- Abortion services
- RTI services

The identification of activities (including activities that involve the provision of goods and services) is critical to the specification of transactions. The development of a classification of activities in the area of reproductive health may benefit from the experience of SIDALAC (2001), PHRplus and others in developing HIV/AIDS accounts.

De *et al.* (2004a) distinguish the following services:

- Family planning services
 - Retail pharmaceutical sales of products such as oral contraceptives, condoms and spermicides.
 - Outpatient services (counselling, IUD insertions, injectables)
 - Inpatient services (female and male surgical sterilisation)
 - Services that support or promote family planning
 - IEC, public awareness, health education campaigns
 - Training, research
- Prenatal care and delivery

D: *Activities Included in the ICPD Costed Population Package*

According to Paragraph 13.14 of the Programme of Action of the ICPD, basic reproductive health includes the following major components:

- a) *Family-planning services*: contraceptive commodities and service delivery; capacity building for information, education and communication regarding family planning and population and development issues; national capacity-building through support for training; infrastructure development and upgrading of facilities; policy development and programme evaluation; management information systems; basic service statistics; and focused efforts to ensure good quality care.
- b) *Basic reproductive health services*: information and routine services for prenatal, normal and safe delivery and post-natal care; abortion (as specified in paragraph 8.25 of the ICPD document); information, education and communication about reproductive health, including sexually transmitted diseases, human sexuality and responsible parenthood, and against harmful practices; adequate counselling; diagnosis and treatment for sexually transmitted diseases and other reproductive tract infections, as feasible; prevention of infertility and appropriate treatment, where feasible; and referrals, education and counselling services for sexually transmitted diseases, including HIV/AIDS, and for pregnancy and delivery complications.
- c) *Sexually transmitted diseases/HIV/AIDS prevention programmes*: mass media and in-school education programmes, promotion of voluntary abstinence and responsible sexual behaviour and expanded distribution of condoms.
- d) *Basic research, data and population and development policy analysis*: capacity building through support for demographic as well as programme-related data collection and analysis.

Source: <http://www.unfpa.org/sustainable/popups/icpd-ch13.htm>, accessed 31 July 2004.

E: Categories and Examples of Population and AIDS Activities (RF Project)

Category	Examples of project, programmes and activities
1. Family planning services: • Contraceptive commodities and service delivery • Capacity-building for information, education and communication (IEC) regarding family planning and population and development issues • National capacity-building through support for training • Infrastructure development and upgrading of facilities • Policy development and programme evaluation; • Management information systems • Basic service statistics • Focused efforts to ensure good quality care	Examples of category 1: • Family planning projects • Family planning information systems • Construction/infrastructure of family planning clinics • Soap series on TV about family planning • Procurement of contraceptives • Contraceptive supply • Family planning training
2. Basic reproductive health services given at primary health care level: • Information and routine services for prenatal care, normal and safe delivery, postnatal care • Abortion (as specified in paragraph 8.25 of the ICPD document) • Information, education and communication (IEC) about reproductive health, human sexuality and responsible parenthood, and against harmful practices • Adequate counselling • Diagnosis and treatment for reproductive tract infections, as feasible • Prevention of infertility and appropriate treatment, where feasible • Referrals, education and counselling services for pregnancy and delivery complications	Examples of category 2: • Upgrading maternity wards • Training of traditional birth attendants • Refresher course for midwives • Safe Motherhood programmes
3. Sexually transmitted disease and HIV/AIDS activities: a) STD activities • STD prevention and care services • STD diagnosis and treatment • Promotion of voluntary abstinence and responsible sexual behaviour b) HIV/AIDS prevention • Voluntary counselling and testing (VCT) • Prevention of mother to child transmission of HIV (MTCT) • IEC about HIV/AIDS prevention	Examples of category 3: • IEC about STDs • STD sentinel and behavioural surveillance • Policy, advocacy, administration and research, school-based AIDS education

• Blood safety • HIV/AIDS prevention strategies – peer outreach for out-of-school youth, public sector condom promotion and distribution c) HIV/AIDS treatment/care • Palliative care for people living with HIV and AIDS • Treatment for opportunistic infections • Access to essential HIV/AIDS care programmes, including drugs, prophylaxis for opportunistic infections d) HIV/AIDS social mitigation/support • Promotion and protection of human rights of HIV-infected people • Legal support services for people living with HIV/AIDS • Humanitarian assistance for people affected by HIV/AIDS	• Support to MTCT programmes; post-exposure prophylaxis (PEP) • Prevention programmes, including those in the workplace, targeted at vulnerable groups, e.g., youth, women, men having sex with men (MSM), intravenous drug users • HIV/AIDS prevention related research • Diagnosis, counselling and referrals to care services • Multidrug-resistant (MDR) TB and HIV care • Highly active antiretroviral therapy (HAART), including laboratory services for monitoring treatment • Support to national strategic plans on HIV/AIDS; • Support to children orphaned by AIDS • Surveillance of HIV infection and AIDS prevalence • Psychological support for HIV/AIDS affected people and families • Support to networks of people living with HIV/AIDS
4. Basic research, data and population and development policy analysis: • National capacity-building through support for demographic as well as programme-related data collection and analysis, research, policy development and training • Support for population data collection, support to academic and other training institutions for population and development research and analysis and to national population planning units, population councils, and population commissions.	Examples of category 4: • Demographic and health surveys • Sending staff to overseas training courses • Setting up a demography department at a university • Population censuses

F: Reproductive Health Account Functions Classification

Health care functions		Examples
HC. 1-7	Direct health care functions	
HC.1	Services of curative care	
HC.1.1	Inpatient curative care	
HC.1.1.1	RH related inpatient curative care	Including accommodation costs
HC.1.1.1.1	Obstetric care	Assistance by trained attendants of vaginal delivery, caesarean section, surgery, anaesthesia, blood transfusion; antibiotics, oxytocic drugs, sedatives for eclampsia, manual removal of placenta, removal of retained products
HC.1.1.1.2	Fistula reconstruction surgery	
HC.1.1.1.3	Treatment for reproductive tract infections	Treatment of female and male tract infections, e.g., vaginal, pelvic, cervical and urinary tract infections (inpatient)
HC.1.1.1.4	Treatment of RH-related cancers	Treatment of uterine, cervical, ovaria, breast, prostate, testicular cancer; radiotherapy
HC.1.1.1.5	Health-related abortion	Abortion related to health of the mother (inpatient)
HC.1.1.1.6	Psycho-social support to mothers	Support to mothers in case of loss of child
HC.1.1.1.7	STI management	STI diagnosis and treatment
HC.1.1.1.8	Treatment of infertility	Treatment of infertility and sub-fertility; in vitro fertilisation (IVF) (inpatient)
HC.1.1.1.9	All other inpatient RH-related curative care	
HC.1.1.2	HIV/AIDS-related inpatient curative care	
HC.1.1.2.1	OI treatment and monitoring	
HC.1.1.2.9	All other inpatient HIV/AIDS-related curative care	
HC.1.3	Outpatient curative care	
HC.1.3.5	RH-related outpatient curative care	
HC.1.3.5.1	Treatment for reproductive tract infections	Treatment female and male tract infections, e.g., vaginal, pelvic, cervical and urinary tract infections (outpatient)
HC.1.3.5.2	Treatment of RH-related cancers	Treatment of uterine, cervical, ovarian, breast, prostate, testicular cancer; radiotherapy
HC.1.3.5.3	Health-related abortion	Abortion related to health of the mother (outpatient)
HC.1.3.5.4	Psycho-social support to mothers	Support to mothers in case of loss of child
HC.1.3.5.5	STI management	STI diagnosis and treatment
HC.1.3.5.6	Treatment of infertility	Treatment of infertility and sub-fertility (outpatient)
HC.1.3.5.9	All other outpatient RH-related curative care	
HC.1.3.6	HIV/AIDS-related curative care	
HC.1.3.6.1	OI treatment and monitoring	
HC.1.3.6.2	ARV treatment	Highly active anti-retroviral therapy (HAART)
HC.1.3.6.3	Psychosocial support	Birth attendance at home
HC.1.3.6.9	All other outpatient HIV/AIDS-related curative care	
HC.1.4	Services of curative home care	
HC.1.4.1	Obstetric services	Birth attendance at home

HC.2	Services of rehabilitative care	
HC.2.1	Inpatient rehabilitative care	
HC.2.1	Inpatient rehabilitative care for RH-related cancer	
HC.2.4	Services of rehabilitative home care	
HC.2.4.1	Rehabilitative home care for RH-related cancer care	
HC.2.4.2	Post-delivery rehabilitative home	Maternity care
HC.3	Services of long-term nursing care	
HC.3.1	Inpatient long-term nursing care	
HC.3.1.1	Palliative care for RH-related cancer patients	
HC.3.1.2	Palliative care for PLWHA	
HC.3.3	Long-term nursing care: Home care	
HC.3.3.1	Palliative care for RH-related cancer patients	
HC.3.3.2	Palliative care for PLWHA	
HC.4	Ancillary services to medical care	
HC.4.1	Clinical laboratory	
HC.4.1.1	Pregnancy tests	
HC.4.1.2	Diagnosis for RTI	Diagnosis for vaginal, pelvic, cervical and urinary tract infections; PAP smears
HC.4.1.3	STI-related lab services	Lab monitoring for STI
HC.4.1.4	HIV/AIDS-related lab services	Lab monitoring for HIV, HAART, immunology
HC.4.1.9	All other RH-related lab services	
HC.4.2	Diagnostic imaging	
HC.4.2.1	Diagnostic imaging for MTP	Diagnostic imaging for medical termination of pregnancy
HC.4.2.2	HIV/AIDS diagnostic imaging	
HC.4.2.9	All other RH-related diagnostic imaging	Mammograms, imaging of uterine, cervical, ovarian, breast, prostate, testicular cancers
HC.4.3	Patient transport and emergency rescue	
HC.4.3.1	Transport for emergency obstetric care	
HC.4.3.2	Transport for other RH-related inpatient curative care	
HC.4.3.3	Transport for RH-related outpatient curative care	
HC.4.3.4	Transport for RH-related diagnostic services	
HC.4.9	All other miscellaneous ancillary services	
HC.4.9.1	Attending to inpatients by family members and relatives	Expenses for food and accommodation of patient's attendants
HC.4.9.9	Other miscellaneous ancillary services	
HC.5	Medical goods dispensed to outpatients	
HC.5.1	Pharmaceuticals and other medical non-durables	
HC.5.1.1	Prescribed medicines	
HC.5.1.1.1	STI medication	Antibiotics
HC.5.1.1.2	RTI medication	Antibiotics
HC.5.1.1.3	Prescribed contraceptive commodities	Oral contraceptives
HC.5.1.1.4	Other RH-related prescribed medicines	

HC.5.1.1.5	ARV drugs	ARV drugs as prescribed medicines for outpatients
HC.5.1.1.6	OI drugs	Prophylaxis for opportunistic infections
HC.5.1.2	Over-the-counter medicines	
HC.5.1.3	Other medical non-durables	
HC.5.1.3.1	Safe-delivery kits	
HC.5.1.3.2	Condoms	
HC.5.1.3.3	Contraceptive commodities other than condoms	Spermicides, IUDs
HC.5.1.3.4	Pregnancy tests	Over-the-counter pregnancy tests
HC.5.1.3.9	All other medical non-durables	
HC.6	Prevention and public health services	
HC.6.1	Maternal health; family planning and counselling	
HC.6.1.1	Maternal health	Tetanus toxoid immunisation, hookworm treatment, detection and management of complications (e.g., pre-eclampsia), antenatal check-ups, safe motherhood counselling and referral, registration of pregnant women (NB: diagnosis and management of tract infections is included in HC.1.1.1.3 or HC.1.3.5.1)
HC.6.1.1.1	Prenatal care	
HC.6.1.1.2	Postnatal care	Post-delivery check-ups and referral
HC.6.1.1.3	Women's nutrition	Provision of dietary supplements to during and after pregnancy women (e.g., iron, folic acid and other minerals and vitamins)
HC.6.1.2	Family planning service delivery	
HC.6.1.2.1	Family planning counselling	Counselling and referral, including genetic counselling
HC.6.1.2.2	Permanent methods of family planning	Female and male sterilisation
HC.6.1.2.3	Temporary methods of family planning	IUD insertions, injectables (NB: oral contraceptives and condoms are included in category HC.5.1.3)
HC.6.1.2.4	Abortion	Abortion and post-abortion care (abortion related to health of the mother in HC.1.1.1.5 or HC.1.3.5.3)
HC.6.3.	Prevention of communicable diseases	
HC.6.3.1	HIV/AIDS prevention	
HC.6.3.1.1	Counselling and testing	Voluntary counselling and testing (VCT) and referral
HC.6.3.1.2	Blood safety	Screening of donated blood
HC.6.3.1.3	Post exposure prophylaxis (PEP)	PEP use for exposed health workers or other high-risk groups
HC.6.3.1.4	Needle programmes	Needle exchange programmes
HC.6.3.1.5	Health workers protection	Disposable bins, protective wear
HC.6.3.1.6	Condom distribution programmes	Condom promotion and distribution (specifically aiming at HIV/AIDS)
HC.6.3.1.6.1	Targeted interventions	Interventions aiming at high-risk groups, e.g., commercial sex workers, truckers, migrant workers, street children
HC.6.3.1.2	Blood safety	Screening of donated blood
HC.6.3.1.3	Post exposure prophylaxis (PEP)	PEP use for exposed health workers or other high-risk groups
HC.6.3.1.4	Needle programmes	Needle exchange programmes
HC.6.3.1.5	Health workers protection	Disposable bins, protective wear
HC.6.3.1.6	Condom distribution programmes	Condom promotion and distribution (specifically aiming at HIV/AIDS)

HC.6.3.1.6.1	Targeted interventions	Interventions aiming at high-risk groups, e.g., commercial sex workers, truckers, migrant workers, street children
HC.6.3.1.6	General programmes	
HC.6.3.1.7	Prevention of mother to child transmission of HIV	Breastfeeding intervention, provision of ART drugs during pregnancy and at time of delivery
HC.6.3.1.9	All other HIV/AIDS prevention activities	
HC.6.3.2	STI Prevention programme	Prevention of infertility and sub-fertility
HC.6.3.2.1	Condom distribution programmes	Condom promotion and distribution (not specifically aiming at HIV/AIDS)
HC.6.4	Prevention of non-communicable diseases	
HC.6.4.1	Prevention of RH-related cancer	
HC.6.6	IEC/BCC on reproductive health practices	Including mass media, magazines, posters and targeted programmes (school and peer education); community/group level communication; including male involvement programmes
HC.6.6.1	IEC&BCC on safe motherhood	
HC.6.6.2	IEC&BCC on family planning	Campaigns for natural methods (abstinence, rhythm, breastfeeding)
HC.6.6.3	IEC&BCC on infertility	Promotion of voluntary abstinence and responsible sexual behaviour
HC.6.6.4	IEC&BCC on sexual health	
HC.6.6.5	IEC&BCC on STI prevention	Promotion of voluntary abstinence and responsible sexual behaviour
HC.6.6.6	IEC&BCC on HIV/AIDS prevention	
HC.6.6.6.1	Targeted interventions	IEC aiming at high risk groups, e.g., commercial sex workers, truckers, migrant workers, street children (excl. school)
HC.6.6.6.2	School AIDS education programme	School-based education
HC.6.6.6.9	All other IEC/BCC on HIV/AIDS	Workplace prevention programmes; promotion of voluntary abstinence and responsible sexual behaviour
HC.6.6.9	IEC/BCC on all other reproductive health practices	IEC&BCC about harmful practices (e.g., female genital mutilation)
HC.7	Health administration and health insurance	
HC.7.1	General government administration of health	
HC.7.1.1	General government administration of health (except social security)	Formulation, administration, coordination and monitoring of health policies, plans, programmes and budgets; management information systems, monitoring and evaluation, basic service and health statistics (not compilation), preparation and enforcement of legislation (governmental)
HC.7.1.2	Administration, operation and support of social security funds	
HC.7.2	Health administration and health insurance: Private	
HC.7.2.1	Health administration and health insurance: Social insurance	Administration and operation of private social health insurance
HC.7.2.2	Health administration and health insurance: Other private	Administration and operation of all other private health and accident insurance, including private for-profit insurance
HC.nsk	HC expenditure not specified by kind	

HC.R.1-5	Health-related functions	
HC.R.1	Capital formation for health care provider institutions	Infrastructure development and upgrading of facilities, e.g., clinics, lab facilities, drug supply/storage systems
HC.R.1.1	Infrastructure development and upgrading in curative and preventive health care provider institutions	
HC.R.1.1.1	Primary health care	
HC.R.1.1.2	Secondary health care	
HC.R.1.1.3	Tertiary health care	
HC.R.1.2	Infrastructure development and upgrading in the delivery of diagnostic health care services	
HC.R.1.3	Non-clinical system improvements	
HC.R.2	Education and training of health personnel	Medical education and in-service training for paramedical workers; universities and nursing schools; training on capacity-building for IEC
HC.R.2.1	Health personnel education and training on RH (not related to HIV/AIDS)	Education and training on RH, including maternal health, family planning, STI; e.g., training TBAs, refresher course midwives
HC.R.2.2	Health personnel education and training on HIV/AIDS	Training on treatment and protection
HC.R.3	Research and development in health	Basic and applied research (including data collection), and experimental development; research to improve programme performance
HC.R.3.1	R&D in RH (not related to HIV/AIDS)	Data collection (DHS, surveillance), (policy) analysis, (operations) research in RH, including maternal health family planning, STI and sexuality
HC.R.3.2	R&D in HIV/AIDS	Data collection, (policy) analysis, prevention and cure research (e.g., vaccine and microbicide research)
HC.R.3.2.1	HIV sentinel surveillance	
HC.R.3.2.2	Autopsies of HIV/AIDS patients	
HC.R.3.2.9	All other R&D in HIV/AIDS	
HC.R.nsk	HC.R expenditure not specified by kind	
Addendum functions		
AD.1	Provision of social services in kind to assist living with disease	
AD.1.1	Support to people with RH problems (not related to HIV/AIDS)	Support to people with infertility, fistula stigma reduction, empowerment
AD.1.2	Support to PLWHAs	Legal support services for/in-kind benefits (e.g., nutritional support) to/empowerment and organisation, human rights protection, stigma reduction of PLWHA
AD.2	Policy advocacy	
AD.2.1	Policy advocacy on RH (not related to HIV/AIDS)	Support to national strategic plansSupport to national strategic plans on family planning and RH or to alternative plans
AD.2.2	Policy advocacy on HIV/AIDS	Support to national strategic plans on HIV/AIDS or to alternative plans

Italic type indicates the subtitle of a group of functions.

Source: Prepared by Bart de Bruijn and Ronald Horstman, NIDI.

G: *International Classification for Health Accounts – Functional Classification of Health Care (ICHA-HC)*

Code	Description
HC. 1-5	Direct Health Care Functions
HC.1	Services of curative care
HC.1.1	Inpatient curative care
HC.1.2	Day cases of curative care
HC.1.3	Outpatient curative care
HC.1.3.1	Basic medical and diagnostic services
HC.1.3.2	Outpatient dental care
HC.1.3.3	All other specialised medical services
HC.1.3.4	All other outpatient curative care
HC.1.4	Services of curative home care
HC.2	Services of rehabilitative care
HC.2.1	Inpatient rehabilitative care
HC.2.2	Day cases of rehabilitative care
HC.2.3	Outpatient rehabilitative care
HC.2.4	Services of rehabilitative home care
HC.3	Services of long-term nursing care
HC.3.1	Inpatient long-term nursing care
HC.3.2	Day cases of long-term nursing care
HC.3.3	Long-term nursing care: home care
HC.4	Ancillary services to medical care
HC.4.1	Clinical laboratory
HC.4.2	Diagnostic imaging
HC.4.3	Patient transport and emergency rescue
HC.4.9	All other miscellaneous ancillary services
HC.5	Medical goods dispensed to outpatients
HC.5.1	Pharmaceuticals and other medical non-durables
HC.5.1.1	Prescribed medicines
HC.5.1.2	Over-the-counter medicines
HC.5.1.3	Other medical non-durables
HC.5.2	Therapeutic appliances and other medical durables
HC.5.2.1	Glasses and other vision products
HC.5.2.2	Orthopaedic appliances and other prosthetics
HC.5.2.3	Hearing aids
HC.5.2.4	Medico-technical devices, including wheelchairs
HC.5.2.9	All other miscellaneous medical goods
HC.6	Prevention and public health services
HC.6.1	Maternal and child health; family planning and counselling
HC.6.2	School health services
HC.6.3	Prevention of communicable diseases
HC.6.4	Prevention of non-communicable diseases
HC.6.5	Occupational health care

HC.6.9	All other miscellaneous public health services
HC.7	Health administration and health insurance
HC.7.1	General government administration of health
HC.7.1.1	General government administration of health (except social security)
HC.7.1.2	Administration, operation and support of social security funds
HC.7.2	Health administration and health insurance: private
HC.7.2.1	Health administration and health insurance: social insurance
HC.7.2.2	Health administration and health insurance: other private
HC.nsk	HC expenditure not specified by kind
HC.R.1–5	Health-Related Functions
HC.R.1	Capital formation for health care provider institutions
HC.R.2	Education and training of health personnel
HC.R.3	Research and development in health
HC.R.4	Food, hygiene and drinking-water control
HC.R.5	Environmental health
HC.R.nsk	HC.R expenditure not specified by kind

Source: WHO (2003:28).

Demography, Growth, Income Distribution and Poverty: A Survey of Interrelationships

*Ali Abdel Gadir Ali**

In order to survey the interrelationships between demography, on the one hand, and economic growth, income distribution and poverty, each on the other hand, it is perhaps important to flag a number of basic demographic terms and concepts.

Abstracting from large-scale migration flows, the population growth rate is usually measured as the birth rate minus the death rate. The birth and death rates are usually expressed as numbers per thousand of the population, but the population growth rate is usually expressed in percentage terms. The demographic history of the world is usually discussed in terms of these demographic rates (i.e., the famous demographic transition).

Over the period 1950–1955 the average annual rate of population growth for the world is reported to have been 1.81 per cent with Latin America and the Caribbean recording the highest rate of 2.65 per cent followed by Africa (2.21), while Europe recorded the lowest rate of 0.99 per cent. Between 1995 and –2005, the average annual rate of population growth for the world declined to 1.21 per cent while that of Africa declined marginally to 2.18 per cent, with Africa now recording the highest population growth rate followed by Latin America and the Caribbean (1.42 per cent), and Europe recording a zero rate of growth.

Aggregate population rates of change, it is customary to note, hide fairly important information about the underlying demographic structure of various countries. Such structures are usually looked at in terms of the age distribution of the population involved. Standardised age groups are 0–15 years of age (young dependent population), 15–64 years of age (working population), and 65 years and over (old dependent population). The latest available age distribution for the world (for 2005) indicates that the young represent about 28.2 per cent of the population and the old to represent about 7.4 per cent, leaving a share of about 64.5 per cent of the population for the working age group. For Africa as a whole, the young represent about 41.5 per cent of the total population with the old accounting for about 3.4 per cent, leaving 55.1 per cent of the total population as a share of the working age

* I am grateful to the participants in the AERC workshop held in Kampala, Uganda, on 15–16 March 2007 for helpful comments, which were communicated to me in writing by Professor Olu Ajakaiye.

group. Thus Africa is clearly characterised by a young population.¹ Population Division (2006:24, Table II. UN 1). Indeed, Africa is the youngest continent.

This characteristic is usually summarised in the dependency ratio, defined as the population of the young and the old as a share of the working age population. For the world the dependency ratio is reported as 55.1 per cent; for Africa it is 81.3 per cent, the highest of all continents.

It is also customary to note that aggregate population rates of change are affected by the prevailing age distributions in various countries. Important in this respect is the age-specific fertility rate, which is defined as the average number of children per year born to women in a particular age group. The total fertility rate is the sum of the age-specific fertility rates over different age groups, thus giving the average number of children a woman is expected to have over her lifetime. According to UN estimates, total fertility for the world was 2.65 children per woman in 2000–2005; Africa's 4.97 children per woman was the highest among all continents, followed by that for Latin America and the Caribbean (2.55), with Europe recording the lowest fertility (1.4 child per woman).²

With respect to mortality the recent UN (2006:54) report notes that life expectancy at birth provides a commonly used measure to summarise mortality conditions for a period of time (e.g., a five-year period as in the 2004 Revision). In contrast to age-specific fertility rates, life expectancy provides a convenient, standardised measure (unaffected by age structure differences) for comparing mortality over time and across populations. According to UN estimates life expectancy at birth averaged 65.4 years at the level of the world for the period 2000–2005. All continents achieved a life expectancy in excess of 60 years except for Africa, which marked only 49.1 years, a decline from 51.5 years for the period 1985–1990. "Africa, unlike other major areas, has been experiencing declining life expectancy since the late 1980s.... While the downward trend in (SSA) is due in large part to the HIV/AIDS epidemic, other factors also played a role, including armed conflict, economic stagnation and resurgent infectious diseases such as tuberculosis and malaria. The recent negative trends in Africa have set back progress in reducing mortality by at least 25 years" (UN, 2006:56).³

The long history of population change in the world is customarily described in terms of the demographic transition theory. Theory is usually summarised in terms of three phases. During the first phase a spontaneously high rate of reproduction was countered with all manner of disasters, such as regular outbreaks of plague, pestilence, and famine. So although birth rates were high, death rates were sufficiently high to keep growth rates down to a crawl (Ray, 1998:302). This low population growth rate phase was followed by the second phase of high population growth (or population explosion) thanks to the advent of sanitation methods (which resulted in the decline of death rates) and technological advances that raised agricultural productivity (increasing the carrying capacity of societies). Moreover, birth rates remained high during this second phase because of the observed inertia

that characterises fertility choices made by households. In the third phase there was a decline in the birth rates and with declining death rates, population growth rates also declined. European and North American regions of the world are said to have experienced this three-phase population history, and developing countries it is conjectured are currently going through the same process.

The rest of this chapter is organised in six sections. The next section suggests a unifying framework for investigating the interrelationships in question.⁴ The framework is based on the dominant money-metric methodology for poverty analysis.⁵ This is followed by an account of the interrelationships between population change and growth, and between inequality and poverty. The chapter argues that these interrelationships could be informed at the micro household level by the usual poverty profile analysis. The last section outlines conclusions and recommendations for policy relevant research.

A Unifying Framework

Relevant literature suggests that the interrelationships among demography, growth, income distribution and poverty could best be addressed in the context of poverty changes over time. In general, any poverty measure (call it P) could be expressed as depending on mean consumption expenditure in society, the poverty line, and on a measure of the underlying inequality in the distribution of consumption. One of the axioms on poverty measures, the scale invariance axiom,⁶ enables a general form of any poverty measure to be expressed in the following way:

$$P = P(\mu/z, \theta); \text{ such that: } \partial P / \partial \mu < 0; \partial P / \partial z > 0; \text{ and, } \partial P / \partial \theta > 0 \quad (1)$$

where μ is mean consumption expenditure, z is the poverty line and θ is a measure of the inequality in the distribution of consumption expenditure usually taken as the Gini coefficient. The theoretical restrictions on this general form are such that as per capita consumption increases (poverty line declines), all things being equal, poverty declines. Similarly, as inequality in the distribution of consumption expenditure declines, other things remaining the same, poverty declines. Note that in this general formulation if the poverty line changes by the same rate of change as mean consumption expenditure, all things being equal, poverty does not change.⁷ Note also that if the poverty line is set as a constant proportion of mean consumption expenditure, then poverty changes will only depend on the change in the distribution of consumption expenditure.⁸

Without loss in generality we denote the expenditure-poverty line ratio by $\lambda (= \mu/z)$. The general poverty measure can now be expressed as the following:

$$P = P(\lambda, \theta); \text{ such that } \partial P / \partial \lambda < 0; \text{ and, } \partial P / \partial \theta > 0 \quad (2)$$

Discrete changes in poverty over two periods (0 and 1) can be obtained by considering changes in poverty due to a change in the consumption poverty-line ratio (reflecting the effect of economic growth) and the change in the distribution of

consumption expenditure (reflecting an inequality component). These changes can be looked at using the initial period as a reference point, or alternatively using the terminal period as a reference point. Averaging over these two changes gives rise to an exact decomposition of the change in poverty (the so-called Shapely value).

Equation 3 gives the decomposition of poverty change using the initial period as the reference where the change in poverty $\Delta P = P(\lambda_T, \theta_T) - P(\lambda_0, \theta_0)$:

$$\Delta P = [P(\lambda_T, \theta_T) - P(\lambda_T, \theta_0)] + [P(\lambda_T, \theta_0) - P(\lambda_0, \theta_0)] \quad (3)$$

The first term on the right-hand side of (3) is the inequality component of poverty change: the consumption ratio is held constant and the poverty measure is evaluated at the initial distribution. The second term is the growth component of poverty change where the distribution is held constant but the consumption ratio is allowed to change.

Similarly, Equation 4 gives the decomposition of poverty change when the terminal period is used as a reference:

$$\Delta P = [P(\lambda_T, \theta_T) - P(\lambda_0, \theta_T)] + [P(\lambda_0, \theta_T) - P(\lambda_T, \theta_0)] \quad (4)$$

The first term on the right-hand side of (4) is the growth component while the second term is the distribution component. Adding equations (3) and (4), collecting terms and rearranging, we get the change in poverty between two periods as:

$$\begin{aligned} \Delta P = & 0.5 \{ [P(\lambda_T, \theta_0) - P(\lambda_0, \theta_0)] + [P(\lambda_T, \theta_T) - P(\lambda_0, \theta_T)] \} \\ & + 0.5 \{ [P(\lambda_T, \theta_T) - P(\lambda_T, \theta_0)] + [P(\lambda_0, \theta_T) - P(\lambda_0, \theta_0)] \} \end{aligned} \quad (5)$$

The first term on the right-hand side of (5) is the overall growth component, while the second term is the overall inequality component.

A careful reading of the specialised literature on the economic impact of demographic change would reveal that such impact is postulated to materialise through economic growth channels and inequality in the distribution of income or consumption channels. Either explicitly or implicitly such literature looks at both λ (i.e., both per capita consumption expenditure and the poverty line) and θ (i.e., income shares of the various percentile groups or summary measures of inequality such as the Gini coefficient) as functions of real per capita income (representing the stage of development).

To account appropriately for the impact of demographic change in the growth component of the change in poverty, the specialised literature makes a first distinction between output per worker, say w , and output per capita, say, y . The literature further notes the obvious relationship between the two in the form of the identity given by the following where Y is total output, L is the number of workers and N is total population:

$$y = Y/N = (Y/L) (L/N) = w (L/N) \quad (6)$$

Denoting the growth rate for any variable x , by $G(x)$ we have:

$$G(y) = G(w) + G(L) - G(N) \quad (7)$$

From Equation 7 it is noted that for a stable population $G(L) = G(N)$ and the net demographic effects are zero. "If the population is unstable as during a transition, then demography matters" (Williamson, 2003: 113). The channel of the effect of demography on the growth process is then embedded in a conventional neoclassical growth model (i.e., $G(w)$) of the transition to the steady state where per worker output is determined by a vector of variables (policy, institutional, geographic and social).

On the basis of the foregoing, the consumption-poverty line ratio is assumed, either explicitly or implicitly, to be a function of per capita GDP. Most of the literature assumes that the poverty line is constant over space, at one point in time, as well as over time, across space. More reasonably, the poverty line, interpreted as the cost of survival in a social context, can be assumed to be a function of per capita consumption expenditure (representing the standard of living in developing countries). Thus, λ , the ratio of consumption expenditure to the poverty line can also be considered as a function of GDP. The change over time of this ratio will depend on the size of the elasticity of the poverty line with respect to consumption expenditure, as well as on the elasticity of per capita expenditure with respect to GDP per capita. With appropriate substitution of Equation 7, the impact of demography on poverty can thus be captured.⁹

The demographic impact on changes in poverty over time through the distribution component is captured through a Kuznets relationship. Over long periods of time the Kuznets hypothesis asserts that inequality in the distribution of income tends to increase first as per capita income increases before it declines. Per capita income in this respect is supposed to capture the development process. Under such a process we have:

$$\theta = \theta(y) \text{ such that } [\partial\theta/\partial y] > 0 \text{ as } y < y^* \quad (8)$$

where y^* is the Kuznets turning point.

The framework above is obviously macroeconomic in nature in the sense that the units of analysis are countries, regions or sectors within countries. However, owing to the reliance of the framework on the distribution of the standard of living among families, and individuals representing families, the framework could easily be linked to the microeconomic level. The interrelationships in question have been debated in the specialised literature in the context of the effect of large family size on the welfare of families. Two views are identified in the debate. One view notes that high 'fertility in poor families may reflect parents' sensible decisions to trade off current consumption for greater future family income when children begin work, or for greater old age security, or it may simply reflect parents' decisions to enjoy children rather than other forms of consumption. The fact that large families tend to have lower incomes should not be construed as meaning that they either are,

or that they regard themselves as being, objectively worse-off (Birdsall and Sinding, 2003: 15–16). The second view notes that at least some fertility among the poor may not have been chosen either implicitly or explicitly to optimise family welfare and as such may not be optimal.

The underlying framework for either of the two arguments is the standard household choice model, where the choices of a household with respect to fertility are treated in an analogous manner to all other decisions. A possible formulation of such decisions is one of a utility maximising representative household. Let x be parental consumption, n the number of surviving children, q the level of human capital (child quality) achieved by each child, and $U(x, n, q; \alpha)$ the utility function of the household with α a vector of exogenous factors influencing the preferences of the household. With this notation a representative household is assumed to maximise its utility subject to a production technology constraint for producing human capital of children and a budget constraint. Production of child quality, q , depends on the consumption of children, c , and time devoted to rearing and caring for them by their parents, s , and a vector of factors affecting production, β . Thus without loss in generality such production constraint could be formulated as:

$$qn = Q(c, s; \beta) \quad (9)$$

With family wages given by w , the budget constraint facing the household could be formulated as:

$$w(1-s) = p_x x + p_c c \quad (10)$$

where the p 's are prices of the consumption goods in question.

In defending a variant of this approach Behrman (2003: 375) notes that:

if individual decision-makers do behave as if they are maximising their welfare given their resources broadly defined and the constraints that they face, they will make investments at the level at which the additional (marginal) present discounted value of the private benefit of the investment equal its additional (marginal) present discounted value of the private cost.... Examples of such investments include population changes such as having more children.

As usual, private marginal benefit curves are postulated as downward sloping, while private marginal cost curves are assumed to be upward sloping. An optimum investment is identified as the point where the two curves intersect. Shift vectors, α for preferences and β for production technology, among other changes during the development process, could then be invoked to look at policy issues occasioned by the divergence between private costs and benefits from social costs and benefits. Examples of causes of such divergence related to population change and development are enumerated by Behrman (2003:381–3).

Demographic Change and Economic Growth

According to Williamson (2003:11), what matters most in identifying the impact of demographic change on economic performance is the changing age distribution. It is argued that in the early stages of demographic transition, per capita income growth suffers because of large youth dependency burdens and small shares of working-age adults (i.e., relatively few workers and savers). As the transition proceeds, per capita income growth is promoted by smaller youth dependency burdens and larger working-age adult shares: there are relatively many workers and savers. The early burden of having few workers and savers becomes a potential gift: a high share of working-age adults. Later, the economic gift evaporates, as the elderly shares rises.

Such linkages have been explored using conventional growth regressions on a world sample of 78 countries over the period 1965–1990 by Bloom and Williamson (1998). As usual the dependent variable is the average growth rate of real GDP per capita over the period. Explanatory variables include the rate of growth of population over the period; the logarithm of initial income relative to that of the US (i.e., the ratio of GDP per capita to that of US GDP per capita in 1965); the logarithm of life expectancy in 1960; and the logarithm of years of secondary schooling in 1965. Others are natural resource abundance; openness; quality of institutions; access to ports; average government savings over the period 1970–1990; tropics location; and, ratio of coastline distance to land area.

Initial regression runs indicate the coefficient of the population growth rate to be sensitive to the specification as to which explanatory variables are included. Thus, for example, an initially insignificant coefficient turns to become significant when the logarithm of life expectancy, tropics location and ratio of coastline to land area are added. Population growth is revealed to be positively, and significantly, related to the growth rate of per capita GDP (see Bloom and Williamson, 1998: 434, Table 2; Williamson, 2003:114, Table 5.1). To appropriately account for both population growth and the demographic transition the growth rate of the economically active population over the period 1965–1990, and its difference from the population growth rate, are added as explanatory variables. A summary of the OLS results is presented in Table 7.1, where figures in parentheses are absolute *t*-values.

Table 7.1: The interrelationship between demography and economic growth (*t*-statistics)

Explanatory variables	1	2
Growth rate of economically active population (G(L)1965–1990)	1.46 (4.3)	
Growth rate of population (G(P) 1965–1990)	-1.03 (2.6)	
G(L) – G(P)		1.68 (4.8)
Logarithm of initial relative GDP per capita (relative to US: 1965)	-2.00 (9.5)	-1.97 (9.0)
Logarithm of life expectancy 1960	3.96 (4.1)	2.94 (3.0)
Logarithm of years of secondary schooling 1965	0.22 (1.6)	0.28 (2.0)
Natural resource abundance	-2.35 (2.4)	-2.57 (2.3)
Openness	1.92 (6.0)	1.72 (5.2)
Quality of institutions	0.20 (2.9)	0.15 (2.1)
Access to ports (landlocked)	-0.64 (9.1)	-0.40 (1.5)
Average government savings 1970–1990	0.12 (4.0)	0.13 (4.3)
Tropics location	-1.31 (4.4)	-1.20 (3.9)
Ratio of coastline distance to land area	0.24 (2.2)	0.23 (1.9)
Constant	-19.5 (4.5)	-14.3 (3.5)
Adjusted R ²	0.86	0.85

Note that the paper reports standard errors; the *t*-values reported above are approximated to the first digit.

Source: Bloom and Williamson (1998: 436, Table 3) and Williamson (2003: 116, Table 5.2).

The most important results from the perspective of exploring the interrelationship between demography and economic growth, as indicated in Table 7.1, may be summarised as follows:

- The growth rate of the economically active population tends to have a positive impact on GDP per capita growth. Such impact is statistically significant and rather large: a 1 per cent increase in the growth rate of the working population, other things remaining the same, is associated with about 1.5 per cent increase in the growth rate of GDP per capita (column 1);
- The growth rate of population tends to have a negative impact on GDP per capita growth. Such impact is statistically significant and also relatively large: a 1 per cent decrease in the rate of population growth, other things remaining the same, is associated with about 1 per cent increase in the growth rate of GDP per capita (column 1); and
- When the growth rates of the working-age and the entire population are constrained to be equal but of opposite sign, to take account of the changes in the age distribution, the results show a positive and statistically significant relationship. This implies that where the middle of the age distribution (ages 15–64) grows faster than the tails (ages 15 and below and 65 and above), GDP per capita growth is faster (Williamson, 2003:116).

Having noted the above, it is perhaps instructive to point out that a fairly large literature has developed in an attempt to explain sub-Saharan Africa's (SSA) slow growth performance compared with other regions. This literature, using global samples, followed a standard approach of including a dummy variable that takes the value of one for SSA countries and zero otherwise. The coefficient of this dummy variable is usually found to be negative and statistically significant, implying that SSA's growth is on average lower than that for other countries and that such a difference cannot be explained by the standard growth regression model. In a recent paper, Hoeffler (2002) argued that, an augmented Solow model, where human capital is included in the production function, can account for SSA growth.¹⁰

She suggested that previous studies did not take into account initial differences across countries (thus encountering the econometric problem of omitted variables) and that they did not take into account that while investment causes growth, economic growth could also cause investment (thus encountering the econometric issue of endogeneity). To correct for these she uses the generalised method of moment's estimation, which overcomes both technical problems. A comparison of the results of this method of estimation with those of ordinary least squares and of fixed effects shows that the significance of the SSA dummy depends on the method of estimation. The simple growth model used in the literature, with an appropriate method of estimation, shows that SSA growth has been low because of initial differences, low investment in human and physical capital, and comparatively high population growth.

Demographic Change and Income Distribution

Because demographic change has at its core the passage of time, it is perhaps not surprising that the relationship between such change and its impact on income inequality has been explored in the context of the famous Kuznets curve hypothesis. The Kuznets hypothesis, it will be recalled, argues that inequality in the distribution of income tends to increase during the early stages of development, before it declines at later stages. To capture both the development process and the time dimension involved, development is usually proxied by real per capita GDP. Various formats have been tried in the literature for testing the non-linear relationship between inequality and development. The pioneering attempts by Ahluwalia (1976) used the income share of the richest 20 per cent of the population as the dependent variable in a quadratic relationship with GDP per capita as the explanatory variable. Recent contributions by, among others, Barro (1998) and Milanovick (1994) used the Gini coefficient as the dependent variable under the quadratic format. Anand and Kanbur (1976a/b), however, have indicate that the appropriate format to use for the Gini coefficient is one of GDP per capita and its reciprocal, rather than its squared value.

Williamson (2003:131–2) reports results on the Kuznets curve where the Gini coefficient is used as the dependent variable. The explanatory variables used are the logarithm of GDP per worker and its squared value (to represent the stage of

development); arable land per capita (to represent resource abundance); the Sachs and Warner openness measure; secondary school enrolment rate (to represent the supply of education); and the share of the adult population between ages 29 and 60 in the population aged 15–69 (to capture the demographic structure of the population).

In terms of the demographic variable two ideas are explained:

First, poor people tend to be either young or old. Secondly, people in fat cohorts tend to get low rewards, and when those fat working-adult cohorts tend to lie in the middle of the age-earnings curve when incomes are highest, the age-earnings curve tends to be flattened, and inequality is moderated. When instead the fat cohorts are younger or old working adults, the age-earnings curve will rise to and fall from its peak more steeply and inequality is moderated. (Williamson, 2003:131–2).

With an adjusted R-squared of about 0.5, the results revealed that all the estimated coefficients are significantly different from zero at the 1 per cent level, except for the openness variable, which is significant at 10 per cent level. The Kuznets hypothesis is confirmed with the coefficient on the logarithm of GDP per worker positive (0.000036) and that on its squared value negative (-8.73E-10). The coefficient on the resource abundance variable is positive; implying that resource-abundant economies tend to have unequal income, and that on secondary school enrolment is negative with the obvious interpretation that increased educational availability tends to reduce inequality in the distribution of income. The coefficient on the openness variable is positive, being interpreted as implying that non-socialist economies tend to have more inequality. This interpretation is based on the observation that the original Sachs and Warner measure is dominated by whether the country is or was socialist, being 0 if it was (Williamson, 2003:131).

The coefficient on demographic structure is negative (-2.95), confirming the two ideas noted above. An increase in the ratio of the adult working population relative to total working population, all things being equal, is expected to result in a decline in inequality.

Demographic Change and Poverty

In a very interesting paper Eastwood and Lipton (2003:212–59) addressed the issue of the interrelationship between the demographic transition and poverty. For a full sample of 59 countries, their preferred equation, from among seven estimated equations, has the head-count ratio (for a PPP poverty line of US\$30 per person per month) as the dependent variable. The natural logarithm of real consumption expenditure per head, the ten-year lagged net birth rate, an interaction term between the two, and a dummy for Latin America are the explanatory variables. In another equation it is found that the population growth rate lagged ten years is as good as the birth rate, while social variables (including the Gini coefficient of land ownership at the year of the survey, population per nurse and primary school

enrolment rate lagged ten years from the year of the survey) were found not to be significant either individually or collectively. A summary of these results is presented in Table 7.2, where figures in parentheses are t-values for the coefficients and p-values for the Wald test.¹¹

Table 7.2: Demography and poverty: Eastwood and Lipton results (t-statistics)

Explanatory variables	1	2
Natural logarithm of mean consumption expenditure	-8.13 (0.93)	-21.94 (3.54)
Net birth rate lagged 10 years from year of survey (= crude birth rate lagged 10 years minus infant mortality rate lagged 10 years)	3.41 (3.32)	
Population growth rate lagged 10 years from year of survey		24.85 (2.39)
[Natural logarithm of mean consumption expenditure][Net birth rate lagged 10 years]	-0.64 (2.67)	
[Natural logarithm of mean consumption expenditure][Population growth rate lagged 10 years]		-4.37 (1.84)
Dummy for Latin America	9.97 (3.78)	8.69 (3.13)
Adjusted R-squared	0.854	0.843
Wald test for mean consumption expenditure	198.0 (0)	234.9 (0)
Wald test for demographic variable	31.6 (0)	25.76 (0)

Source: Eastwood and Lipton (2003: Table 9.2, p. 224)

Note that the specification of the regression equation allows the authors to have a poverty elasticity of growth that varies with the demographic variable due to the interaction term and the semi-logarithmic format. Similarly, the estimated coefficients are not directly interpretable as marginal effects of demography. The marginal effects of demography on poverty depend on the level of per capita consumption expenditure per person. This, of course, is an attractive feature. As a result marginal effects of demography on the incidence of poverty are calculated for various percentiles of the distribution of consumption expenditure. Thus, for example, the marginal effect of an increase in the net birth rate at the median of the logarithm of mean consumption expenditure “is of the order of 0.6”; that at the 25th percentile is of the order of 0.85; and that at the 75th percentile “is of the order of 0.33”. Similarly, the marginal effect of an increase in the population growth rate at the median of the logarithm of mean consumption expenditure is of the order of 5.7; that at the 25th percentile is of the order of 7.4; and that at the 75th percentile is of the order of 3.8 (see Eastwood and Lipton, 2003: Table 9.3, p. 227).

Putting these results in context, we can predict that a hypothetical median country would attain, by virtue of a the fall of 4 per 1,000 in the net birth rate in the pre-survey decade, a fall of 2.4 percent” in the head-count ratio “via the distribution channel alone”. For a country at the 25th percentile of the (consumption distribution), the predicted fall would be about 3.4 percent (Eastwood and Lipton, (2003: 225).¹²

Despite the excitement of the authors with their results a careful scrutiny of their results would reveal that their specification of the poverty equation is problematic in the sense that it concentrates on only one of the fundamental determinants of poverty (i.e., per capita consumption expenditure) and ignores the other (i.e., any measure of the inequality in the distribution of consumption expenditure such as the Gini coefficient). In what follows we reveal that appropriately specifying the poverty equation gives rise to results that are distinctly different from those of Eastwood and Lipton (2003). The data set we use is from Dollar and Kraay (2002) and the details of the variables used are presented in the Appendix to this chapter. We note that we calculated the poverty related variables from the distribution information in the Dollar and Kraay data set where we allowed the poverty line to change with the standard of living. The population growth rate is the ten-year average preceding the survey for each of the countries involved. The tables present the results for the appropriately specified poverty equation where the natural logarithm of the poverty measures is regressed on its fundamental determinants (i.e., the consumption expenditure/poverty line ratio and the Gini coefficient) before we introduce the population growth variable and its interaction with each of the fundamental determinants. Two specifications for the logarithm of the poverty measure are reported: a linear and a logarithmic function. Absolute *t*-values, which are White heteroscedasticity-consistent, are reported in parentheses, and where as usual stars over the *t*-values indicate the standard levels of significance with one star meaning significance at the 1 per cent level or better and three stars indicating significance at the 10 per cent level.¹³ Table 7.3 reports the results for the spread of poverty where the poverty measure is the head-count ratio.

Columns 1–4 report the results for the linear format for the explanatory variables. The first column gives the fundamental poverty equation, where the dependent variable is the head count ratio. The results confirm our expectations, at a statistically significant level, that an increase in per capita consumption expenditure, all things being equal, reduces the spread of poverty, and a reduction in the Gini coefficient, all things being equal, is expected to reduce the spread of poverty. It is important to note, however, that the two fundamental determinants explain about 80 per cent of the observed variation in measured poverty in the sample. Column 2 adds the population growth rate revealing that all things being equal, an increase in the population growth rate reduces the spread of poverty. This effect, however, is statistically insignificant implying that at this level of aggregation demographic considerations do not affect the spread of poverty. Note also that adding the demographic dimension does not improve the explanatory power of the estimated equation. Column 3 keeps the population growth rate in addition to interacting it with the standard of living variable.

Table 7.3: Population growth and the spread of poverty (t-statistics)

Explanatory variable	1	2	3	4	5	6	7	8
Consumption expenditure/ Poverty line ratio ($l=m/z$)	-0.6681 (12.4)*	-0.6759 (11.6)*	-0.3022 (1.5)	-0.6991 (12.9)*				
Gini Coefficient	0.0358 (6.1)*	0.0359 (6.2)*	0.0347 (5.8)*	0.0774 (6.3)*				
Ln ($l=m/z$)					-1.3230 (12.9)*	-1.3377 (11.7)*	-0.7461 (1.6)	-1.3657 (12.5)*
Ln Gini coefficient					1.5619 (5.9)*	1.5659 (5.9)*	1.5344 (5.7)*	3.1703 (5.3)*
Population growth rate		-0.0171 (0.3)	0.3202 (1.7)***	0.7483 (3.2)*		-0.0166 (0.3)	0.1693 (1.2)	2.4881 (2.6)**
[Population growth rate] [$l=m/z$]			-0.1397 (1.6)				-0.2180 (1.2)	
[Population growth rate] [Gini coefficient]				-0.0170 (3.1)*				
[Population growth rate] [Ln ($l=m/z$)]								
[Population growth rate] [Ln Gini coefficient]								-0.6603 (2.6)**
Constant	3.2262 (12.6)*	3.2806 (9.4)*	2.4061 (4.9)*	1.4566 (2.8)*	-1.5959 (1.6)	-1.5594 (1.5)	-1.9632 (1.8)***	-7.6286 (3.4)*
Adjusted R-squared	0.8052	0.8004	0.8069	0.8442	0.8079	0.8032	0.8041	0.8324

*Statistically significant at 1 per cent level

** Statistically significant at 5 per cent level

*** Statistically significant at 5 per cent level

As is clear from the results, the standard of living variable loses its significance on its own while the Gini coefficient continues to be a significant determinant of the spread of poverty. The population growth rate becomes significant on its own (at the 10 per cent level of significance) such that, other things remaining the same including the interaction term, an increase in the population growth rate will be expected to increase the spread of poverty. The interaction term between population growth and the standard of living variable is border-line significant at the 10 per cent level (with a p-value of 0.1023). Thus, the marginal effect of the population growth rate on the spread of poverty depends on the stage of development of the country as proxied by the standard of living variable and is given by $(0.3202 - 0.1397\lambda)$: the higher the stage of development the lower is the impact of population

growth on the spread of poverty. Indeed, it is an easy matter to show that population growth will be neutral for a value of $\lambda=2.29$.

Column 4 introduces the interaction term between the population growth rate and the Gini coefficient. In this equation all estimated coefficients are significant at the 1 per cent level or better. Moreover, the variables in question seem to provide more explanation compared with the fundamental equation of the first three columns, albeit a marginal increase in the adjusted r-squared. In this equation an increase in the rate of population growth on its own, other things remaining the same including the interaction term, is expected to increase the spread of poverty. However, the marginal effect of the population growth rate depends on the degree of inequality in the distribution of consumption expenditure, and is given by $(0.7483 - 0.017\theta)$. For a Gini coefficient of 44.02 per cent, demographic variables are neutral with respect to the spread of poverty.

Columns 5–8 report the results for the log-linear format for the explanatory variables. Column 5 gives the fundamental poverty equation. Under this format the estimated coefficients of the fundamental determinants give the partial elasticity of the head-count ratio with respect to each of its two determinants. The results confirm our expectations, at a statistically significant level, that an increase in per capita consumption expenditure, all things being equal, reduces the spread of poverty; and a reduction in the Gini coefficient, all things being equal, is expected to reduce the spread of poverty. It is important to note, once again, that the two fundamental determinants explain about 81 per cent of the observed variation in measured poverty in the sample. Moreover, it may be instructive to note that although the absolute value of income elasticity of the head-count ratio (1.32) is lower than that of the distribution elasticity (1.56); in general the head-count ratio is not very sensitive to the inequality dimension. Column 6 adds the population growth rate indicating that all things being equal, an increase in the population growth rate reduces the spread of poverty! This effect, once again, is statistically insignificant implying that at this level of aggregation demographic considerations do not affect the spread of poverty. Note also that adding the demographic dimension does not improve the explanatory power of the estimated equation. Column 7 keeps the population growth rate in addition to interacting it with the logarithm of the standard of living variable. As is clear from the results, the standard of living variable loses its significance on its own while the Gini coefficient continues to be a significant determinant of the spread of poverty. The population growth rate, and its interaction with the logarithm of the standard of living, is not significant. Thus, the marginal effect of the population growth rate on the spread of poverty is almost zero. Column 8 introduces the interaction term between the population growth rate and the logarithm of the Gini coefficient. In this equation all estimated coefficients are significant at the 1 and 5 per cent levels.

Moreover, the variables in question seem to provide more explanation compared with the fundamental double log equation of columns 5–7, albeit a marginal increase in the adjusted r-squared. In this equation an increase in the rate of

population growth on its own, all things being equal including the interaction term, is expected to increase the spread of poverty.

However, the marginal effect of the population growth rate depends on the degree of inequality in the distribution of consumption expenditure, and is given by $(0.5305 - 0.012 \theta)$. For a Gini coefficient of 43.85 per cent, demographic variables are neutral with respect to the spread of poverty.

Results on the interrelationship between population growth and depth of poverty are reported in Table 7.4. The dependent variable is the natural logarithm of the poverty-gap ratio.

Table 7.4: Population growth and the depth of poverty (*t*-statistics)

Explanatory variable	1	2	3	4	5	6	7	8
Consumption expenditure/ Poverty line ratio (m/z)	0.8752 (8.8)*	0.9252 (9.4)*	0.3364 (0.4)	0.9692 (11.1)*				
Gini coefficient	0.0628 (5.6)*	0.0635 (5.8)*	0.0616 (5.3)*	0.1423 (5.1)*				
Ln (m/z)					-1.7341 (9.3)*	-1.8184 (9.7)*	-0.9030 (1.0)	-1.8874 (10.8)*
Ln Gini coefficient					2.7921 (5.5)*	2.8184 (5.7)*	2.7689 (5.3)*	6.0185 (4.7)*
Population growth rate	-0.1098 (1.1)	0.4215 (1.2)	1.3438 (2.7)*		-0.1095 (1.1)	0.1822 (0.7)	4.8862 (2.5)**	
[Population growth rate] [m/z]			-0.2201 (1.3)					
[Population growth rate] [Gini coefficient]				-0.0322 (2.8)*				
[Population growth rate] [Ln m/z]							-0.3422 (0.9)	
[Population growth rate] [Ln Gini coefficient]								-1.3171 (2.5)**
Constant	1.3515 (2.8)*	1.7015 (2.5)**	0.3239 (0.4)	-1.7629 (1.6)	-7.0770 (3.7)*	-6.8346 (3.4)*	-7.4693 (3.7)*	-18.9408 (3.9)*
Adjusted R-squared	0.6773	0.6780	0.6817	0.7445	0.6797	0.6804	0.6782	0.7299

*Statistically significant at 1 per cent level

** Statistically significant at 5 per cent level

*** Statistically significant at 5 per cent level

As with the spread of poverty, two specifications for the logarithm of the poverty measure are reported: a linear and a logarithmic function. Absolute t-values, which are White heteroscedasticity-consistent, are reported in parentheses. Stars marking the t-values indicate the standard levels of significance, with one star meaning significance at the 1 per cent level or better and three stars indicating significance at the 10 per cent level.¹⁴

Columns 1–4 of Table 7.4 report the results for the linear format for the explanatory variables. The first column gives the fundamental poverty equation. The results confirm our expectations, at a statistically significant level, that an increase in per capita consumption expenditure, all things being equal, reduces the depth of poverty; while a reduction in the Gini coefficient, all things being equal, is expected to reduce the depth of poverty. The two fundamental determinants explain about 68 per cent of the observed variation in measured poverty in the sample. Column 2 adds the population growth rate showing that other things remaining the same, an increase in the population growth rate reduces the depth of poverty. But this effect is statistically insignificant, implying that at this level demographic considerations do not affect the depth of poverty. Note also that adding the demographic dimension does not improve the explanatory power of the estimated equation. Column 3 keeps the population growth rate and adds its interaction with the standard of living variable. As is clear from the results the standard of living variable loses its significance on its own while the Gini coefficient continues to be a significant determinant of the depth of poverty. The coefficients of the population growth rate, and its interaction with the standard of living variable, are statistically insignificant. Thus, the depth of poverty does not seem to be sensitive to demographic variables through the channel of the standard of living.

Column 4 introduces the interaction term between the population growth rate and the Gini coefficient. In this equation all estimated coefficients of the explanatory variables are significant at the 1 per cent level or better. Moreover, the variables in question seem to provide more explanation compared to the fundamental equation of the first three columns, albeit a marginal increase in the adjusted r-squared. In this equation an increase in the rate of population growth on its own, all things being equal including the interaction term, is expected to increase the depth of poverty. However, the marginal effect of the population growth rate depends on the degree of inequality in the distribution of consumption expenditure, and is given by $(1.3438 - 0.0322 \theta)$. For a Gini coefficient of 41.6 per cent demographic variables are neutral with respect to the depth of poverty.

Columns 5–8 report the results for the log-linear format for the explanatory variables. Column 5 gives the fundamental poverty equation. Under this format the estimated coefficients of the fundamental determinants give the partial elasticity of the poverty-gap ratio with respect to each of its two determinants. The results confirm our expectations, at a statistically significant level, that an increase in per capita consumption expenditure, all things being equal, reduces the depth of poverty. A reduction in the Gini coefficient, all things being equal, is expected to

reduce the depth of poverty. It is important to note, once again, that the two fundamental determinants explain about 68 per cent of the observed variation in measured poverty in the sample. Moreover, it may be instructive to note that the absolute value of income elasticity of the poverty-gap ratio (1.73) is almost half that of the distribution elasticity (2.79), both suggesting that the depth of poverty is generally more sensitive than the spread of poverty with respect to the two fundamental determinants of poverty. Column 6 adds the population growth rate indicating that all things being equal, an increase in the population growth rate reduces the depth of poverty. This effect, once again, is statistically insignificant implying that at this level demographic considerations do not affect the depth of poverty. Note also that adding the demographic dimension does not improve the explanatory power of the estimated equation. Column 7 keeps the population growth rate in addition to interacting it with the logarithm of the standard of living variable.

As is clear from the results, the standard of living variable loses its significance on its own while the Gini coefficient continues to be a significant determinant of the depth of poverty. The population growth rate, and its interaction with the logarithm of the standard of living, is not significant. Thus, the marginal effect of the population growth rate on the depth of poverty is almost zero. Column 8 introduces the interaction term between the population growth rate and the logarithm of the Gini coefficient. In this equation all estimated coefficients are significant at the 1 and 5 per cent levels. Moreover, the variables in question seem to provide more explanation compared with the fundamental double log equation of columns 5–7, albeit a marginal increase in the adjusted r-squared. In this equation an increase in the rate of population growth on its own, all things being equal including the interaction term, is expected to increase the depth of poverty. However, the marginal effect of the population growth rate depends on the degree of inequality in the distribution of consumption expenditure, and is given by $(4.8862 - 1.3171 \theta)$. For a Gini coefficient of 40.85 per cent demographic variables are neutral with respect to the depth of poverty.

The Micro Dimension

Within the context of the unifying framework the micro – household level – interrelationships among demographic variables, income distribution and poverty, can be explored through poverty profiles. Poverty profiles reveal differences in the relative poverty of certain subgroups of the population, and analysis of the poverty profiles is essential for understanding the causes of poverty. Such profiles could be descriptive or causal.

Following the identification of the poor, through an appropriately calculated poverty line, a poverty profile can be constructed using the available information in the household budget survey. A descriptive poverty profile is constructed by

comparing the poor and the non-poor households on the basis of a number of dimensions. Examples of the dimensions involved include:

- Household composition and headship (e.g., average size of household; age composition of households; working members; dependency ratios; gender of the head of the household; income of the head of household by gender).
- Dwelling characteristics (e.g., ownership of dwellings; structure of dwellings).
- Education (e.g., average years of schooling and literacy by sector and gender; reasons for leaving school).
- Labour force participation and unemployment (e.g., participation rates; unemployment rates; students and those non-available for work).
- Distribution of labour force (e.g., by sector, gender and type of employment – casual labour, farming, salaried work, self-employment, unemployed).
- Poverty levels by industry of employment: (poverty measures by the industry of employment of the head of the household – agriculture and forestry, manufacturing, construction, trade, community services).
- Child health (e.g., immunisation of 1–5-year-old children, by gender).
- Inter-household transfers (e.g., cash and in-kind transfers to and from households).
- Agricultural land holdings (e.g., poverty measures for households differentiated by their access to, or use of, agricultural land).
- Access to community facilities (e.g., access measured as time taken to reach facilities: different types of school, hospital, market, agricultural services, agricultural cooperative, village savings bank, commercial bank).

A main limitation of the descriptive poverty profile is that while it gives information on who are the poor, it cannot be used to identify the determinants of poverty, and as such cannot address policy questions.

For the purposes of policy analysis, a causal relationship needs to be established between the various household characteristics and the probability of being poor. A number of alternative specifications are available for estimating such a causal relationship using regression techniques. To explore the marginal effects of each of the various factors causing poverty a linear regression specification has recently gained general acceptance.

Under a linear specification the dependent variable is the logarithm of per capita consumption expenditure as a ratio of the poverty line (defined above as the standard of living ratio), so that the poverty status of households is identified by the ratio in question with values close to one indicate that the household is in the

immediate neighbourhood of the poverty line. Denoting the vector of household characteristics by X , the estimating equation can be written as:

$$\text{Log}(\lambda_i) = \alpha + \sum_j \beta_j X_{ji} \quad (11)$$

The vector of household characteristics, X , may include the following broad categories:

- Geographic location (e.g., states or regions).
- Demographic variables (e.g., household size, number of infants and children, age and gender of breadwinner, marital status of breadwinner); and
- Socioeconomic variables (e.g., educational status of head of household, literacy status of spouse, employment status of the head of household, sector of employment, receipt of remittances). Equation 11 can be estimated for sector of residence (i.e., rural-urban) and for the national level.

An example of the results of using the poverty profile to explore the interrelationship between demographic variables and poverty is presented in Table 7.5. The profiles are derived from quintile information provided by the World Bank (2000:383–404) for 22 SSA countries.¹⁵ The information provided is for both rural and urban sectors. For each quintile, in each sector, we computed the ratio of mean consumption expenditure to the poverty line (assumed to be equal to 0.67 of sectoral mean consumption expenditure). For demographic variables we used the age dependency ratio (in percentages), and the average size of the household (number of persons per household). Other explanatory variables used are the employment rate (percentage of members employed), access to sanitation (percentage of households), and access to piped water (percentage of households). Table 7.5 reports our estimation results where figures in parentheses are White-heteroscedasticity-consistent absolute t -values, and where the total number of observations for the rural sector is 110, while that for the urban sector is 70.

Table 7.5: Demographic variables and poverty profiles in sub-Saharan Africa (t -statistics)

Explanatory variables	Rural sector	Urban sector
Age dependency ratio	-0.0123 (3.3)*	-0.0108 (1.8)***
Average household size	-0.1136 (3.0)*	-0.11102 (2.5)**
Proportion of employed persons	0.0080 (2.7)*	0.0102 (1.7)***
Access to sanitation	0.0026 (1.1)	0.0028 (0.8)
Access to piped water	0.0020 (0.42)	0.0033 (0.7)
Constant	1.6630 (4.3)*	0.7929 (1.20)
Adjusted R-squared	0.4121	0.3573

*Statistically significant at 1 per cent level

** Statistically significant at 5 per cent level

*** Statistically significant at 5 per cent level

The results confirm our prior expectation with respect to the interrelationship between the various categories of explanatory variables and poverty. The results for the rural sector show that the coefficients of the population related variables are significantly different from zero at the conventional one per cent level of significance. Surprisingly, the coefficients of the health related variable (access to sanitation and access to piped water) are not significantly different from zero. The estimated equation explains about 41 per cent of the observed variation in the consumption/poverty line ratio among the quintiles in the 22 countries. For the demographic variables it is clear that a decline by about 10 percentage points in the age dependency ratio is likely to increase the consumption poverty line ratio by 0.12 per cent, thus resulting in a decline of any poverty measure by 0.12 (the poverty elasticity with respect to consumption expenditure). Similarly, a decline in the size of the household by one member is expected to increase the consumption poverty line ratio by 0.11 per cent, thus leading to a decline in any poverty by 0.11 (the poverty elasticity with respect to consumption expenditure).

The results for the urban sector, given by the third column in the table are almost identical to those for the rural sector save for the level of significance of the estimated coefficients. The coefficients of the age dependency ratio, and the proportion of people employed are significant at the 10 per cent level while that for the average household size is significant at the 5 per cent level. The estimated equation explains about 36 per cent of the observed variation in the consumption/poverty line ratio among the quintiles in the 22 countries. For the demographic variables, it is clear that a decline by about 10 percentage points in the age dependency ratio is likely to increase the consumption poverty line ratio by 0.11 per cent, thus resulting in a decline of any poverty measure by 0.11 (the poverty elasticity with respect to consumption expenditure). Similarly, a decline in the size of the household by one member is expected to increase the consumption poverty line ratio by 0.11 per cent, thus leading to a decline in any poverty by 0.11 (the poverty elasticity with respect to consumption expenditure).

Concluding Remarks

In this paper we reviewed the evidence on the interrelationships among demography, growth, income distribution and poverty. We suggested that at the macro level such interrelationships could be explored in the context of the standard money metric approach to poverty analysis. In a sense this is an obvious suggestion, in view of the fact that the identification of the poor requires information on the distribution of consumption expenditure so that issues of income distribution are automatically taken into account. Further, changes in poverty over time could easily account for population change especially if the time periods involved are fairly long. Changes in poverty over time involve a growth component and a distribution component. As a result, it is not surprising to note that most of the empirical literature forged the link among demography, growth, income distribution and poverty by looking at the ways and means by which population change can be

introduced in standard empirical growth models. It is through these models, and mechanisms such as the Kuznets hypothesis, that the link with distribution is investigated. It is also suggested that the link between population structure and poverty, given the distribution, can be investigated at the micro level through the use of causal poverty profiles. Such micro links are also aggregative in nature; but it seems that they are the best we have given the data limitation.

With respect to these problematic micro links it is perhaps important to note the in his review of the micro aspects of population change and development Behrman (2003:387) notes that good empirical estimates of the underlying micro relations are very difficult to obtain. One basic problem is that behavioural data, rather than experimental data, generally must be used. Examples of the reviewed empirical aspects include the impact of schooling on population change and productivity (i.e., the rates of return to schooling: including their level, trend over time, gender differentials, behaviour with respect to schooling level and level of income, and the comparison of private and social returns). The international compilation of results from this type of literature has been used by many for increasing policy support, particularly for basic (primary and lower secondary) schooling and particularly for females. But the systematic empirical basis for these policy recommendations is weak (Behrman, 2003:390).

Another example of the reviewed evidence from a micro perspective deals with the question of whether increased non-earned resources at the disposal of women will result in better quality of children in terms of education, health and nutrition. Not surprisingly the cases cited were based on detailed unit record data for households in two countries (Brazil, 25,000 urban households; and Thailand, 8,000 households). These studies have direct relevance to the household decision model noted earlier in of this chapter. They may hold a promising avenue for investigation for SSA, provided relevant data could be accessed.

Despite the difficulties associated with the availability of relevant data for micro investigation of the linkages between demography, growth, income distribution and poverty, it seems reasonable to suggest that there is room for designing special survey instruments to capture the nature of African household decisions in the context of the HIV/AIDS epidemic.

Notes

1. UN Population Division (2006: 40, Table III.4).
2. The UN defines high fertility as total fertility levels of above 5 children per woman; low fertility as levels in the range 2–3 children; replacement fertility as about 2.1 children per woman; below replacement fertility as levels below 2.1 children per woman; and very low fertility levels as those below 1.3 children per woman.
3. High life expectancy is recorded for Japan (81.9 years), Hong Kong (81.5), Iceland (80.6) and Switzerland (80.4 years). At the other extreme, very low life expectancy is

recorded for Swaziland (32.9 years), Botswana (36.6) and Lesotho (36.7). In these three countries, the impact of HIV/AIDS epidemic has lowered life expectancy to a level even lower than that of countries affected by civil strife, such as Sierra Leone (40.6 years) and Angola (40.7 years) (UN, 2006:57).

4. For an earlier investigation of the link between population growth and poverty see Ahlburg (1996), but note that the investigation is not done in the context of a unifying framework.
5. Note that to the extent that multi-dimensional approaches to poverty measurement specify implicitly, or explicitly, cut-off points for the relevant deprivation variables they will be extending the dominant approach to poverty measurement. As such, the proposed unifying framework will hold for such extensions with the appropriate interpretation of the results. For a review of the literature on the multi-dimensional approach to poverty measurement see Bibi (2005).
6. See Zheng (1997) for a survey of axioms and poverty measures.
7. This is the property of zero homogeneity of the poverty measure with respect to mean consumption expenditure and the poverty line. This property is thought to hold for most of the widely used poverty measures.
8. This can easily be established by direct substitution in Equation 1.
9. Note that the growth component of the poverty change over time for the continuous case is given by $[\partial P / \partial \lambda][\partial \lambda / \partial t]$. Now $\partial \lambda / \partial t = \lambda (1 - \varepsilon_z) G(\mu)$, where ε_z is the elasticity of the poverty line with respect to per capita consumption expenditure. Note that $G(\mu) = \varepsilon_\mu G(y)$, where ε_μ is the elasticity of per capita consumption expenditure with respect to GDP per capita (assuming, of course, that the relationship in question is one of constant elasticity).
10. It is important to note that this paper was prepared for an AERC collaborative research project on Explaining African Economic Growth Performance and appeared as CID Working Paper No. 36, in 2000 before it was published. Hoeffler (2006) provides a non-technical summary.
11. The authors explain that because of the interaction terms testing for the significance of a given explanatory variable requires a Wald test of the null hypothesis that both the level and the interaction term can be eliminated. (They) therefore place most weight on the Wald statistics in such cases, paying little attention to the t-statistic on the 'level' terms (Eastwood and Lipton, 2003:223).
12. These results are obtained by multiplying the fall in the net birth rate of 4 per thousand by the calculated marginal effects.
13. Note that the *t*-values are approximated to the first decimal. In the text we will report the p-values whenever that is helpful.
14. Note that the *t*-values are approximated to the first decimal. In the text we will report the p-values whenever that is helpful.
15. The countries involved are Burkina Faso (with a survey for 1994/95); CAR (1993); Côte d'Ivoire (1995); Djibouti (1996); Ethiopia (1995/96); The Gambia (1992);

Ghana (1997); Guinea (1994/95); Guinea Bissau (1992); Kenya (1994); Madagascar (1993/94); Mali (1994); Mauritania (1995); Niger (1995); Nigeria (1992); Senegal (1994/95); Sierra Leone (1989/90); South Africa (1993); Swaziland (1994); Tanzania (1993); Uganda (1992/93); and Zimbabwe (1996).

References

- Ahlburg, D. 1996. "Population growth and poverty". In D. Ahlburg, A.C. Kelley and K.O. Mason, eds., *The Impact of Population Growth on Well-Being in Developing Countries*, pp. 219–58. New York: Springer.
- Ahluwalia, M. 1976. "Inequality, poverty and development". *Journal of Development Economics*, 6: 307–42.
- Anand, S. and R. Kanbur. 1993a. "Inequality and development: A critique". *Journal of Development Economics*, 41: 19–43.
- Anand, S. and R. Kanbur. 1993b. "The Kuznets process and the inequality-development relationship". *Journal of Development Economics*, 40: 25–52.
- Bardhan, P. and C. Udry. 1999. *Development Microeconomics*. Oxford: Oxford University Press.
- Barro, R. 1998. *Determinants of Economic Growth: A Cross-Country Empirical Study*. London: MIT Press.
- Behrman, J. 2003. "Why macro matters". In N. Birdsall, A.C. Kelley and S. Sinding, eds., *Population Matters: Demographic Change, Economic Growth and Poverty in the Developing Countries*, pp. 371–410. Oxford: Oxford University Press.
- Bibi, S. 2005. "Measuring poverty in a multidimensional perspective: A review of the literature". www.pep-net.org. Accessed on 31 December 2006.
- Birdsall, N. 2003. "New findings in economics and demography: Implications for policies to reduce poverty". In N. Birdsall, A.C. Kelley and S. Sinding, eds., *Population Matters: Demographic Change, Economic Growth and Poverty in the Developing Countries*. Oxford: Oxford University Press.
- Birdsall, N. and S. Sinding. 2003. "How and why population matters: New findings, new issues". In N. Birdsall, A.C. Kelley and S. Sinding, eds., *Population Matters: Demographic Change, Economic Growth and Poverty in the Developing Countries*. Oxford: Oxford University Press.
- Birdsall, N., A.C. Kelley and S. Sinding, eds. 2003. *Population Matters: Demographic Change, Economic Growth and Poverty in the Developing Countries*. Oxford: Oxford University Press.
- Bloom, D. and D. Canning. 2003. "Cumulative causality, economic growth and the demographic transition". In N. Birdsall, A.C. Kelley and S. Sinding, eds., *Population Matters: Demographic Change, Economic Growth and Poverty in the Developing Countries*. Oxford: Oxford University Press.
- Bloom, D. and J. Williamson. 1998. "Demographic transitions and economic miracles in emerging Asia". *World Bank Economic Review*, 12 (3): 419–55.

- Boserup, E. 1981. *Population and Technological Change: A Study of Long-Run Trends*. Chicago: University of Chicago Press.
- Cleland, J. and S. Sinding. 2005. "What would Malthus say about AIDS in Africa?" *The Lancet*, 366 (9500): 1899–901.
- Dasgupta, P. 1993. *An Inquiry into Well-Being and Destitution*. Oxford: Clarendon Press.
- Dollar, D. and A. Kraay. 2002. "Growth is good for the poor". *Journal of Economic Growth*, 7: 125–225.
- Eastwood, R. and M. Lipton. 2003. "Demographic transition and poverty: Effects via economic growth, distribution and conversion". In N. Birdsall, A.C. Kelley and S. Sinding, eds., *Population Matters: Demographic Change, Economic Growth and Poverty in the Developing Countries*. Oxford: Oxford University Press.
- Greene, M., and T. Merrick. 2005. "*Poverty Reduction: Does Reproductive Health Matter?*" Health, Nutrition and Population Discussion Paper, The World Bank, Washington D.C.
- Hoeffler, A. 2002. "The augmented Solow model and the African growth debate". *Oxford Bulletin of Economics and Statistics*, 64: 135–58.
- Hoeffler, A. 2006. "Some thoughts on the African growth debate". *Research News*, 9: 24–5. African Economic Research Consortium (AERC), Nairobi.
- Kremer, M. 1993. "Population growth and technological change: One million B.C. to 1990". *Quarterly Journal of Economics*, 108: 681–716.
- Lee, R. 1988. "Induced population growth and induced technical progress: Their interaction in the accelerating stage". *Mathematical Population Studies*, 1: 265–88.
- Merrick, T. 2003. "Population and poverty in households: A review of reviews". In N. Birdsall, A.C. Kelley and S. Sinding, eds., *Population Matters: Demographic Change, Economic Growth and Poverty in the Developing Countries*. Oxford: Oxford University Press.
- Ray, D. 1998. *Development Economics*. Princeton: Princeton University Press.
- UN Population Division. 2006. *World Population Prospects: The 2004 Revision*, Volume III: Analytical Report. www.un.org.
- Williamson, J. 2003. "Demographic change, economic growth, and inequality". In N. Birdsall, A.C. Kelley and S. Sinding, eds., *Population Matters: Demographic Change, Economic Growth and Poverty in the Developing Countries*. Oxford: Oxford University Press.
- World Bank. 2000. *African Development Indicators 2000*. Washington, D.C.: The World Bank.
- Zheng, B. 1997. "Aggregate poverty measures". *Journal of Economic Surveys*, 11 (2): 123–62.

Appendix

Demography and Poverty Data Set

Country	Survey year	Head-count ratio (h; %)	Poverty-gap ratio (p; %)	Gini (%)	Per capita expenditure (i; US\$)	Population growth rate (%)	Poverty line (z; US\$)
BDI	1992	39.51	11.03	33.33	540	2.97	372
BFA	1994	72.57	34.36	48.2	384	2.71	372
BOL	1990	13.54	2.26	42.04	1,272	2.2	420
BRA	1993	37.96	18.92	61.55	2,400	1.88	804
CHN	1990	28.15	8.16	34.6	660	1.44	372
CIV	1993	21.38	5.16	36.91	792	3.79	372
COL	1995	28.56	11.91	57.4	2,496	2.02	828
CRI	1996	23.57	8.13	47.08	2,172	2.55	720
DOM	1989	24.35	8.17	50.46	1,860	2.22	624
ECU	1994	17.93	5	43	1,968	2.35	660
ETH	1995	59.21	20.63	40	264	2.67	216
GIN	1991	46.7	24.12	46.8	552	2.7	372
GNB	1991	57.91	33.04	56.12	504	2.53	372
GTM	1987	32.69	13.21	58.26	1,776	2.42	588
GUY	1993	20.14	6.62	40.22	828	0.73	372
HND	1996	35.42	15.79	53.72	912	2.95	372
JAM	1993	10.45	1.58	37.92	1,404	0.94	504
JOR	1991	12.29	2.96	40.66	1,908	3.74	636
LSO	1993	35.78	17.64	57.94	1,092	0.58	372
MDG	1993	49.29	17.44	46.85	540	2.86	372
MLI	1994	70.37	34.56	50.5	396	2.5	372
MNG	1995	16.98	4.78	33.2	816	1.82	372
MRT	1993	44.72	15.59	50.05	660	2.34	372
NER	1992	58.09	18.91	36.1	336	3.12	288
NGA	1991	42.24	19.01	37.02	600	2.8	372
NIC	1993	23.62	8.45	50.3	1,104	2.47	372
NPL	1995	11.03	1.42	38.78	900	2.42	372
PAN	1995	32.45	16.74	57.07	1,968	2.06	660
PER	1994	19.08	5.09	42.76	1,788	2.08	660
PHL	1991	21.76	4.94	46.08	1,236	2.39	408
PRY	1991	14.19	2.7	59.13	1,632	3.02	552
SEN	1991	35.45	15.94	54.12	900	2.91	372
SLV	1989	22.18	14.25	48.96	1,500	1.07	504
THA	1992	22.21	8.07	51.5	2,124	1.57	708
TUN	1990	11.01	3.32	40.2	1,692	2.47	564
TUR	1994	18.13	5.06	49	2,460	2.14	828
TZA	1991	52.75	18.27	59.01	492	3.31	372
YEM	1992	45.01	16.31	39.5	528	4.05	372
ZAF	1993	40.5	19.72	62.3	1,884	2.34	636
ZMB	1991	64.01	27.12	43.51	408	3.2	372
ZWE	1990	50.98	21.42	56.83	744	3.67	372

Macro Perspectives on the Impact of Demographics on Growth, Income Distribution and Poverty

J. Patrick Sevilla

One of the most fundamental questions in the long history of thought in economics is the precise nature of the relationship between populations and development, in particular whether population growth was a threat to or a facilitator of economic development. There have been, since the seventeenth century, two schools of thought on this issue that have recently been called the pessimistic and optimistic views.

Population Pessimism, Optimism and Neutralism

The pessimistic view is perhaps the more resonant of these two views and received its most famous early description from Thomas Malthus in 1798, with the observation that the world's population would ultimately and rather quickly outstrip its means of subsistence.

Thus progress in food production is always threatened by population pressure. And although agricultural innovations and discoveries of new resources may cause improvements in standards of living, these can be only temporary. Rising prosperity sets in motion more rapid population growth, which drags living standards back to subsistence levels. Malthusian pessimism has persisted through the subsequent two centuries, and lives to this day. Some recent manifestations have been largely alarmist. A famous such example is Ehrlich (1968: xi), who predicted that The battle...is over. In the 1970s hundreds of millions of people are going to starve to death.

The later half of the twentieth century has proved alarmist versions of pessimism to be wrong. At a global level, these have been periods of rapid population growth and rapid economic growth. In the past few decades, world per capita incomes have increased by about two-thirds and the world population has grown by over 2 billion (Bloom *et al.*, 2002). Famines have occurred but Ehrlich's "hundreds of millions" of people have not starved. Technological progress, in both agriculture and industry, has been more rapid than at any other time in human history. There have been equally dramatic social and institutional innovations, in the ways people work, the standard of their education and health, and the extent to which they participate in the political process. Rather than being constrained by fixed resources, the world sees the prices of raw materials in long-term decline; inflation (for the moment at

least) quite low; and some parts of the economy becoming dematerialised as the knowledge revolution kicks in.

While alarmist projections seem largely and appropriately discredited, there remain more sober and carefully reasoned accounts of why large populations and high population growth pose challenges for development. One focuses on the possible effect of population growth in diluting a society's material resources, which have to be spread out over more people. The Solow (1956) model of economic growth remains the foundation of the modern economics profession's view of the relationship between population growth and economic welfare. In that model, population growth lowers levels of per capita consumption because productive resources need to be spread out over a larger number of people, lowering each person's stock of productive resources, and therefore that person's product and wellbeing. Another strand focuses on the possible effect of population growth in "diluting" a society's human capital. Larger population growth invariably occurs through growing numbers of dependent children that jeopardise society's and households' capacities to invest sufficiently in their nutrition, health and education (Becker and Lewis, 1973). In cases of dilution of both physical and human capital, economic growth is threatened and the likelihood of poverty rises.

While pessimism has centred around the idea that population dilutes either natural resources, physical capital or human capital, a rival optimist view has focused on the potential positive impact that population growth might have on ideas, innovation and technology. Optimism has an older and equally venerable lineage as pessimism. As early as 1682, William Petty argued that larger populations meant more innovation:

As for the arts of delight and ornament, they are best promoted by the greatest number of emulators. And it is more likely that one ingenious curious man may rather be found among 4 million than 400 persons....And for the propagation and improvement of useful learning, the same may be said.... (1682/1899, p. 474, quoted in Simon, 1998: 309)

More recently, optimist views have been expressed by Simon Kuznets (1967) and Julian Simon (1981), who argue that population increases serve to augment the stock of human ingenuity and allow economies of scale. Boserup (1981) argues that population growth creates pressures on resources, but thereby stimulates innovations to counteract these pressures. Thus innovation is borne of adversity.

Much empirical research that has tried to investigate the evidence for and against the pessimist and optimist views has found that there seems relatively little compelling evidence for either view (Bloom *et al.*, 2002). While there is a raw empirical association between faster economic growth and slower growth in per capita income across countries, this association disappears once we control for country size, openness to trade, educational attainment, and the quality of civil and political institutions. By the mid 1990s, Kelley and Schmidt (1995:543) describe the evidence as follows:

Possibly the most influential statistical finding that has shaped the population debates in recent decades is the failure, in more than a dozen studies using cross-country data, to unearth a statistically significant association between the growth rates of population and per capita output.

Thus the data on cross-country experiences with population and economic growth provide no strong support for either pessimist or optimist views and has given rise to a third position, which might be called population neutralism.

There seems to be lack of consistent empirical support for either of the grand but simple narratives relating population and growth. However, these narratives have perhaps been too simple, in that they focus too much on the impact of population size and growth, and too little on what could be a critical demographic variable, and that is, age structure. The most important population dynamics of the twentieth century occurred through the demographic transition, which, while having an impact on population growth rates, also had an impact on age structure. This impact has only recently received heightened attention.

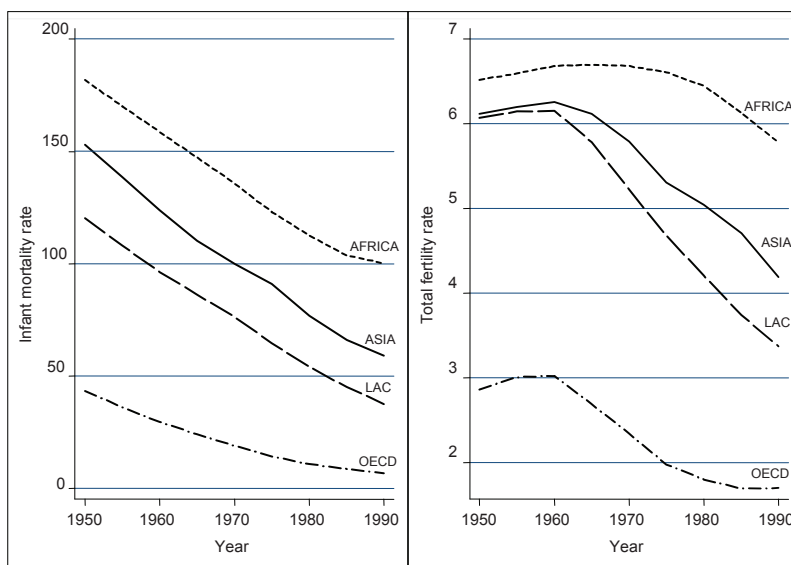
The Impact of the Age Structure

The demographic transition consists of two stages: an initial decline in infant and child mortality followed by reductions in fertility. This transition became a distinct feature of populations all over the world, both rich and poor, after World War II. In the developing countries, the mortality reductions were spurred by developments in medicine and public health such as the use of antibiotics like penicillin, treatment for diseases like TB and diarrhoea, the use of DDT for malaria control, and improved sanitation, hygiene and nutrition. While these reduced mortality risks throughout the population, they were especially effective at reducing infant and child mortality. Figure 8.1 indicates the extent of the declines by region from 1950 to 1990.

Levels of infant mortality differ significantly among the developing regions, but the declines are drastic and surprisingly similar in magnitude: about 95, 80 and 90 per thousand infants in Asia, Africa and Latin America, respectively. The second panel indicates the historical record of the fertility response. Fertility rates increased globally from 1950 to 1960, then began to decline in most parts of the world starting in 1960, and in Africa after 1970. What is evident from the figure is that for both mortality and fertility, the developing world lags far behind the developed world, by at least half a century, and significantly more in the case of Africa.

The combination of falling mortality and steadily increasing fertility over a decade or more contributed to a spurt in population growth rates driven to a great extent by growth in the number of young persons. This phenomenon was widely referred to as the population explosion and was perceived as the central obstacle to development. It was also this phenomenon that led to the resurgence of the population pessimism of Ehrlich.

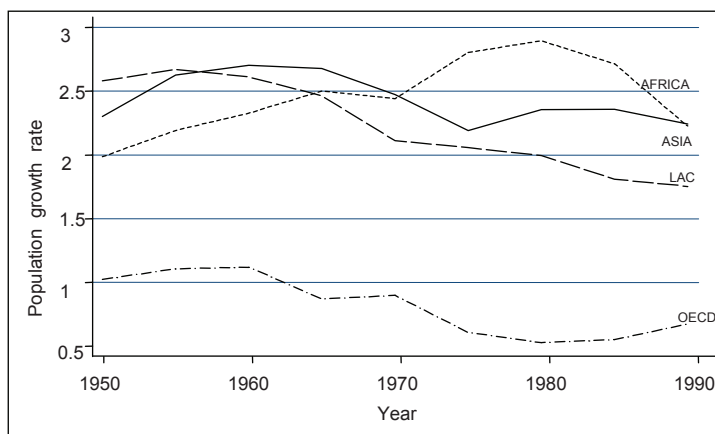
Figure 8.1: IMR and TFR, by region, 1950–1990



Source: UNWPP 2000 and author's calculations using data from United Nations Population Prospects 2000 (United Nations, 2002).

This pessimistic scenario did not come to pass. Fertility declines from the 1960s onwards took the momentum out of population growth. Figure 8.2 indicates that the general pattern of population growth rates is that of growth followed by decline, though the pace of this pattern differs sharply by region: in the developing world, the decline began earliest in Latin America in the mid 1950s, followed in Asia in the early 1960s. It did not begin in Africa till 1980.

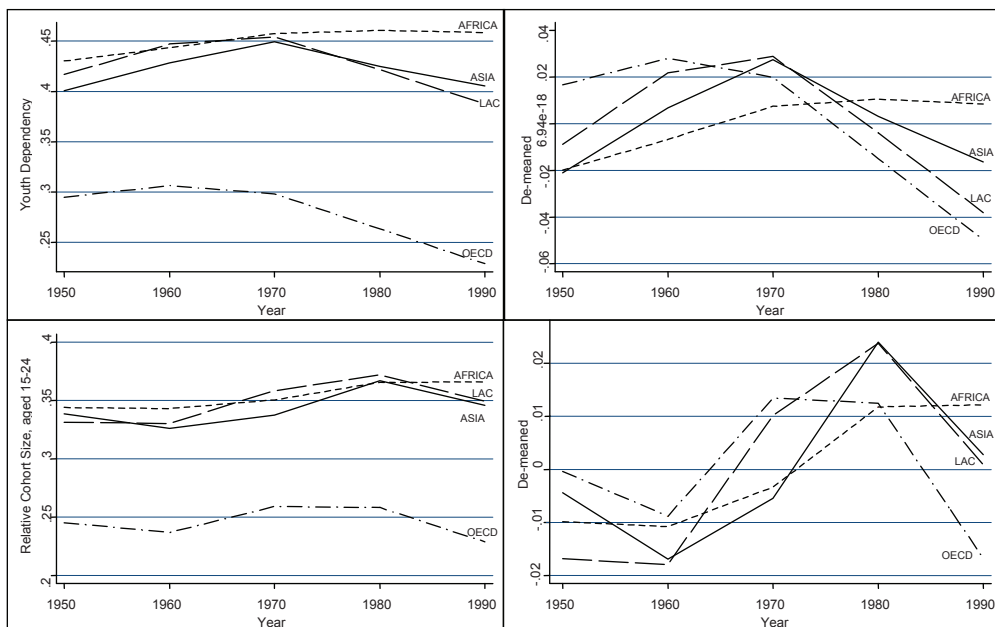
Figure 8.2: Population growth trends, 1950–1990



Source: UNWPP 2000 and author's calculations using data from United Nations Population Prospects 2000 (United Nations, 2002).

The lag between the declines in mortality and fertility created a historically larger than average cohort of children or baby boom: because of increased fertility and survival rates, it was larger than the ones that preceded it, and because of the subsequent fertility decline, it was also larger than the ones that followed. The coming into existence and aging of this cohort produced and continues to produce remarkable changes in the age structure of populations all over the world (Figure 8.3).

Figure 8.3: Youth dependency and young adult relative cohort size



Source: ILO 1997 and author's calculations using data from United Nations Population Prospects 2000 (United Nations, 2002).

The upper left panel indicates the trajectory for the major regions of the youth dependency burden, defined as the ratio of the population aged 0–14 to the population aged 0–64. The birth and early life of the boom cohort is perceived in the gradual increase in the youth dependency burden from 1950 onwards, peaking in 1960 in the countries of the Organisation for Economic Co-operation and Development (OECD), in 1970 in both Asia and Latin America, and levelling off from 1980 onwards in Africa. It is immediately evident that long-term levels of youth dependency are significantly lower in the OECDm, and at least until 1970, they were fairly equal across the developing world. Subtracting regional average dependency burdens over the period 1950–1990, from the data, gives us the upper right panel, which highlights intertemporal variation. What is evident from this panel is that the OECD experienced greater variation than any of the developing regions: its dependency burden was the highest in 1950 yet the lowest by 1990.

Asia and Latin America, on the other hand, had moderate and almost identical experiences. Africa, in contrast, has levelled off and has not yet experienced the declines experienced everywhere else.

The lower panels depict the share of young adults aged 15–24 in the working population aged 15–64. Again, long-term levels are much lower in the OECD, but fairly uniform everywhere else. The de-meaned panel on the right shows this share decreasing from 1950 to 1960, but growing rapidly thereafter. It levels off and declines in the OECD from the 1970s onwards, but keeps rising in the developing region till the 80s, after which it declines in Asia and Latin America, but remains steady in Africa. In contrast to youth dependency, temporal variation in the share of young adults is greater in Asia and Latin America than in the OECD. The demeaned trajectories begin the 1950s much lower in the first two regions, and end much higher in the 1990s.

Figure 8.3 reveals that although the extreme possibility of population growth pressing against the world's carrying capacity did not come to pass, the demographic transition still produced populations with higher shares of dependent youth and young adults. As this youth cohort reaches adulthood, the country experiencing the transition finds itself with a larger share of working age adults. Finally, when the cohort ages, the population finds itself with a higher proportion of retirees.

The movement of this cohort through the population age structure is potentially very important. Although the early part of the demographic transition is characterised by higher population growth, this stage lasts only as long as it takes for fertility rates to decline in response to mortality rates. This may last a generation. The baby boom generation will live for perhaps as much as 70 to 80 years, however, thus far outliving the population growth that accompanied its creation. The impact of the cohort might therefore far outlast the impact of the population growth from earlier on in the transition.

The baby boom generation confronts the economy with challenges and opportunities corresponding to the different stages of its lifecycle. In its early stages, the economy faces the challenges of a high youth dependency. These include the challenges and expenses of feeding, clothing and housing the young and of investing in their health and education. Thus high youth dependency can result in lower human capital expenditures per child. This might occur for the following reasons. First, under some models of fertility determination, fertility may fail to respond optimally to declining mortality rates, making realised fertility higher than desired fertility. In the presence of credit constraints, this causes an unplanned reduction in household resources and human capital expenditures per child. Second, even when fertility is able to respond optimally to declining mortality rates, lower child mortality rates lower the cost of a surviving child. This can cause a substitution effect away from child quality towards child quantity. Third, models of endogenous fertility and human capital choices usually allow for multiple

equilibriums, one of which is characterised by low fertility and high child quality, and the other by high fertility and low child quality. Which equilibrium occurs when depends on history and expectations. The demographic transition causes a general growth in youth dependency that can support the choice of the latter equilibrium.

This higher youth dependency can also reduce savings. The traditional mechanism is given by Coale and Hoover (1958), who hypothesise that higher youth dependency can depress savings and therefore economic growth since households must devote larger shares of household income and resources to raising children. Savings may also be reduced for a second reason, and that is because children are a source of retirement support. Thus if parents have more children, they may feel less need to save for retirement, and therefore save less. One must balance these against some theoretical reasons whereby having more children might raise savings. Indeed according to (Deaton and Paxson, 2000) having more children may raise parental needs to save to provide bequests for their children and grandchildren, or to have resources that can be used to ensure good behaviour among descendants (sometimes called the “strategic bequest” motive).

Fry and Mason (1982) have also argued that demographic effects on savings can interact with economic growth. Economic growth tends to make younger households wealthier than older ones so that the behaviour of younger households is more consequential for national aggregates than that of older households. Thus when economic growth is high, the savings behaviour of younger households is what matters. If these younger households are saving less because they have more children, then national savings are more likely to fall as well.

However, when the baby boom cohort becomes adult, a second stage occurs in which this cohort can provide a boost to economic development through its impact on labour supply, savings and human capital. This large working age cohort affects labour supply in two ways. First, there is an accounting effect. Labour force participation rates are highest among people aged 15 to 64, so that a larger population share in this age group raises labour supply. Second, is a behavioural effect, given that women in this cohort will have lower fertility rates, it is more likely that they will have fewer children and will be more likely to enter the labour force.

This cohort’s effect on savings can likewise be broken down further into an accounting and behavioural effect. Working age adults tend to save a higher proportion of their income than either the youth or the elderly. This is a prediction of both life cycle models of consumption and empirical study of the savings behaviour of adults of different ages (Higgins, 1998; Higgins and Williamson, 1997; Kelley and Schmidt, 1996; Lee *et al.*, 2000; Leff, 1969; Mason, 1988; Webb and Zia, 1990). Thus a larger population share of adults mechanically increases savings. A behavioural response towards increased savings can occur for a few reasons. First, as households decrease in size as a result of lower fertility, then –

according to the traditional Coale and Hoover (1958) hypothesis – such households can save larger fractions of their income. On the other hand, this may be counteracted by increased expenditures per child (Becker and Lewis, 1973). Second, since these cohorts experience longer life expectancies, they need to save more to provide for a potentially longer retirement (Metzler, 1992). Third, according to the Fry and Mason (1982) mechanism, if economic growth is high, then the increased savings of younger households is a strong driver of increased national savings.

Finally, there are effects on human capital. The baby boom generation has lower fertility, and therefore smaller households, which allows households to invest more intensively in each child, reflecting a movement from a demand for child quantity towards quality (Becker and Lewis 1973).

In terms of financial issues, when this cohort reaches old age, society is confronted with the need to provide for the health and pension needs of the elderly. The developed countries, whose baby boom generations are retiring, are already facing these challenges.

A final hypothesis of interest has to do with the possible relationship between cohort size and technological progress. It is possible that while this hypothesis has received the least attention from researchers interested in age structure changes; this may be the most important with respect to long-term economic development. Standard models of economic growth (see Romer, 1996) all argue that sustained long-term growth in standards of living have only one source: productivity growth. If age structure changes have significant effects on productivity, these may in the very long run outstrip all its other consequences in economic significance. For example, it is often argued that population aging and fertility reductions the world over will soon result in large old-age dependent populations supported by much smaller working age cohorts.

The rise in the dependency ratio is often taken to mean that these smaller working cohorts will have to bear the very heavy burden of contributing their own income to provide old-age security. This may be counteracted partially by the fact that labour force participation rates, especially for women, are rising over time, so a given working age population size will, over time, represent more and more active workers on whom elderly populations can depend for support. But more importantly if, as one hypothesis argues, technological progress is stimulated when labour is scarce, then the technological progress that accompanies the shrinking working age population could more than compensate for the increased dependency burden. Thus the direction in which changes in the size of working-age cohort's affects productivity is a central question.

Cutler *et al.* (1990) review the arguments. According to one of their views, exemplified by Simon (1981) and Wattenberg (1987), large young cohorts increase the supply of creative thinkers and potential innovators.

They also constitute a larger market of consumers that allows for greater division of labour, larger markets for capital goods and greater opportunities for realising the economies of scale. This implies that large cohorts stimulate technological progress. According to the opposing view, exemplified by Habakkuk (1962), innovations are more likely to emerge when labour is scarce and innovations are required to relax these constraints. It is when particular segments of the labour market are constrained that innovations are likely to develop that reduce labour requirements. Thus industrialisation occurred faster in the US than in England because the profitability of US agriculture made American labour significantly more expensive than in England, stimulating industrial innovation to economise on its use. These two competing hypotheses have opposing implications for the relationship between youth cohort size and productivity.

In the standard account of economic growth, economic output is determined by a production function that has the following form:

$$Y = f(A, K, EL)$$

where Y is output, A is technology, K is the capital stock, and EL is called effective labour, where L is usually taken to mean labour supply and E is usually taken to mean the human capital possessed by each unit of labour. Thus, economic growth, which is the change in Y over time, is a positive function of growth in technological progress, the capital stock, labour supply and human capital. The foregoing discussion argues that the middle stages of the demographic transition in which the baby boom cohort reaches adulthood has these potentially beneficial consequences for all these determinants of growth. And it is through these four mechanisms – technology, capital, labour supply and human capital – that the demographic transition has its impact on economic growth.

One may raise issues on the impact of demographic on poverty. Macroeconomists such as Adams (2003) have argued that economic growth in and of itself is a significant contributor to poverty reduction. For example, he claims that on average, a 10-percentage-point increase in economic growth produces a 25 per cent decrease in the proportion of people living in absolute poverty (defined as living on an income of less than US\$1 a day). This could happen simply because income distribution within societies tends to be stable and so economic growth becomes the rising tide that lifts all boats. In addition to this mechanism, the demographic transition is driven by fertility reductions, which in turn allow smaller households to finance larger amounts of human capital investments in health and education for their children. On the traditional assumption that these human capital investments should have disproportionately larger benefits for the poor, then the demographic transition will also have distributional consequences that are potentially poverty reducing.

The Centrality of Policy

Theorists of the demographic dividend argue that the mechanisms outlined above create only the potential for such effects, but that this potential only turns into positive economic consequences if the proper policies are in place to facilitate this transformation.

The centrality of policy is highlighted by the differences in economic performance between East Asia on the one hand and Latin America on the other, both of which experienced demographic transitions of similar magnitude and timing, but which resulted in rapid economic growth in the former but not the latter. As the theory of the demographic transition above stated, the early stage of the transition is characterised by high youth dependency burdens putting strains on educational systems and household budgets and savings. The second demographic dividend stage is characterised by an adult rich stage in which the economy receives a boost in labour supply, savings and human capital. The last stage is characterised by a high elderly dependency burden putting strains on the social institutions that provide old age security. Bloom *et al.* (2002) explain the policy challenges associated with each distinct stage of the transition.

Some of the major priority policy areas involve health. In particular, health policies that lower infant and child mortality, and that promote child health are required to facilitate subsequent declines in replacement fertility, to create health human capital among the young, and to generally shift household preferences away from pursuing quantity of children towards quality. Such health investments are likely to subsequently result in improved educational outcomes and a more productive labour supply. In addition, promoting the reproductive and general health of women is a priority. The Population Council estimates that at least 120 million women in the developing countries have unmet needs for contraception, and the UN Population Fund (UNFPA) estimates that half of the world's 175 million pregnancies are either unwanted or untimed (Population Council, 1995; UNFPA, 1999). Improved access to reproductive health services will allow them to reduce fertility in alignment with their desires, and reduce the risk of adverse consequences of childbearing on their health. Improvements in women's general and reproductive health can also result in increased female labour market participation. Other improvements in public health contribute to stimulating the initiation of the demographic transition, including improved sanitation and immunisation programmes, more widespread use of existing treatments, and preventive strategies for diarrhoea, respiratory infections and malaria, all of which contribute to mortality declines among the young and to potential subsequent declines in replacement fertility.

By far the most important health policy challenges posed by demographic forces involve the HIV epidemic. Its primary tragic consequences are humanitarian, but they are also significant for demographic processes such as the demographic transition. HIV has caused dramatic increases in adult mortality rates, which results

in a population age structure that is relatively concentrated among children and the elderly, but relatively thin around the prime adult ages. Thus the epidemic produces an hourglass-like population age structure that is the opposite of that which is required for the demographic dividend, which presupposes a high population share of prime-aged adults. Thus an absolutely critical challenge for Africa, with respect to reaping any demographic dividends is to successfully confront the challenges of the HIV epidemic. Current efforts to counter the epidemic tend to cluster around three themes: prevention, treatment and mitigation of socioeconomic consequences. However, from the point of view of long-term population dynamics and the prospects such dynamics might hold for the demographic transition and demographic dividends, by far the most important challenge lies in effective HIV prevention. The model used by Blower and Farmer (2003), for example, indicates that even if provision of anti-retroviral drugs (ARVs) becomes widespread in developing countries and results in significantly lower transmission rates, HIV incidence could change little or even rise if increases in risky behaviour occur in response.

Another model, based on sub-Saharan African data indicates that, a treatment-centred HIV strategy could have an uncertain impact on new infections (Salomon *et al.*, 2005), but a prevention-centred strategy could reduce new infections by 36 per cent. A joint strategy of prevention and treatment therefore, would reduce infections by 55 per cent. In a jointly released press-statement in early 2007, the WHO and UNAIDS outlined policy steps regarded as the foundation of comprehensive HIV prevention strategies. The steps include male circumcision, voluntary counselling and testing (VCT) services, and treatment for sexually transmitted infections (STIs). A significant part of such a strategy should also be the promotion of safer sex practices including the reduction of concurrent sexual partnerships and the correct and consistent use of condoms.

Once the demographic transition is under way, and the baby boom cohort comes of age, the policy challenges revolve around transforming the economic potential of the baby boom cohort into a reality. These challenges include investments in education to raise the human capital and productivity of the cohort. They also include macroeconomic policies that facilitate the transformation of larger labour supplies into economic output, including relatively flexible labour markets, productive engagement with the global economy and stable macroeconomic policy. And finally, countries desiring to reap the dividend must strengthen the quality of government institutions including the rule of law, the reduction of corruption, and the enforcement of contracts. They must also improve the efficiency of government operations and train skilled public sector workers and civil servants.

Discussion and Critique

Empirical evidence for the impact of the demographic transition on macroeconomic variables, which mostly focuses on the relationship between age structure and savings, remains mixed. Some empirical work argues that its effects are large. Leff

(1969) concluded that the log of gross savings rates was inversely associated with population shares under 15 and older than 64, controlling for log per capita income and its growth over the previous five years. Bloom and Canning (1999) found that the demographic dividend accounts for about one-third of the rapid per capita income growth experienced by East Asia. Mason (2001) calculated that up to one-fourth of this growth is due to demography. Lee *et al.* (2001) performed simulations that imply that demography caused about half of a 20-percentage-point increase in East Asian savings.

But not everyone finds the evidence so compelling. Some criticism revolves around the suspicion that the life cycle hypothesis on which demographic dividend arguments depend – that savings rates are higher for adults, but lower for the young and the elderly – are not robust in the data. In particular there seems to be some evidence that the saving for elderly does not decline as much as the theory predicts. If this is so, then population aging may not have the depressive effect on national saving or economic growth that is theorised by the demographic dividend literature. There is some evidence that this concern is unwarranted, Lee *et al.* (2000, 2001), for example, point out that if life expectancy and wealth are correlated, then it may appear in cross section that saving rises rather than declines with age among the elderly, even if it declines with age within cohorts. Using panel data, Hurd (1990) reveals that older households do in fact decline in savings.

Pritchett (1999) argues that although Latin American countries such as Brazil, Chile and Uruguay experienced similar demographic transitions to those of East Asia, these three countries experienced varied effects on savings. In Brazil, savings was constant; in Chile, it declined then rose, and in Uruguay it declined. Thus, the demographic transition resulted in varying effects on savings across continents and within Latin America.

Deaton and Paxson (2000) investigated the impact of age structure on savings in Taiwan and examine in particular the intermediating role that economic growth can play, as hypothesised by Fry and Mason (1982). They addressed the formidable challenge of constructing life cycle profiles of savings for individuals. The challenge is that data on income and savings are collected at the household level, which means that in practice, when studies try to estimate how savings varies by age, they usually do so by measuring how household saving varies by age of household head. This is not ideal since there is no direct link between individual savings by age and household savings by age of household head. When using better estimates of the age profile of savings by individuals rather than households, the studies find that there is in fact a life cycle pattern to savings, so that greater population shares of the youth and the elderly do in fact depress savings.

Thus one can perceive this as evidence for the life cycle hypothesis being broadly supportive of demographic dividend-type arguments. However, studies also find that the effect of population growth on savings depends on the rate of economic growth, as hypothesised by Fry and Mason. Population growth at the start of the

demographic transition has opposing impacts on national savings. On the one hand, it lowers the population share of elderly dissavers relative to middle-aged savers, which tends to raise national savings. On the other hand, it raises the population share of children, which lowers national savings. Which effect is stronger will depend on the rate of economic growth. At high rates of economic growth, younger households have higher wealth relative to older households, so that their savings behaviour disproportionately affects national savings. And since these younger households save less because of the burden of having more children, national savings also fall. And at low rates of economic growth, older households' relative wealth is higher and their dissaving is a large driver of savings. Population growth, by reducing the population share of the elderly, negates this dissaving and therefore raises national savings. In the case of Taiwan, economic growth falls in the intermediate range whereby the positive and negative impacts of population growth on savings cancel out. Thus while age structure effects exist, intermediate levels of economic growth in Taiwan make them cancel out.

Schultz (2004) argues that a careful re-estimation of data from East Asia demonstrates that the association between age structure and savings is only one fourth that reported in Higgins and Williamson (1997), and that, careful specification eliminates any dependence of savings on age structure. Schultz also indicates that lifetime savings should be considered a substitute for children so that the factors that reduce fertility are the underlying determinants of both the age structure changes and the increased savings.

With respect to the hypothesis regarding the relationship between labour force growth and productivity, Romer (1996) and Cutler *et al.* (1990) both find evidence in the US and in the developed countries suggesting that the relationship is actually negative. That is, the argument put forward by Habakkuk seems to be right: Labour productivity tends to grow fastest when adult cohort sizes shrink. In fact, Cutler *et al.* find that the productivity growth caused by shrinking working age cohorts in the US is more than sufficient to negate the decline in living standards caused by the old-age dependency burden. If this result proves to be robust, and generalises to the developing countries, the alarm with which demographers and economists react to the prospect of population aging and growing elderly dependency ratios is misplaced.

With respect to the relationship between demographics and poverty, there are often-stated correlations between high fertility and poverty, at both national and household levels (Eastwood and Lipton, 2001; Merrick, 2001). For example, Eastwood and Lipton (2001) find in a sample of 45 developing countries that high fertility is associated with higher levels of absolute poverty, and that a 5 per 1,000 reduction in the average country's birth rate would have reduced the incidence of poverty from 18.9 per cent in the mid 1980s to 12.6 per cent in the early 1990s. Merrick (2001:202) claims:

There is little debate about whether poverty and household size are correlated. As Lipton noted in 1983, "almost every study, at whatever level of

disaggregation, for either a particular group or for a total population, demonstrates the incidence of poverty and mean household size increasing together”.

How should one interpret these correlations? Anand and Morduch (1996) argue, contrary to the claims of Lipton and Merrick, that such correlation between household size and poverty should not be taken for granted. Using data from Bangladesh they demonstrate that the correlation between household size and poverty may be due to mis-measurement, in particular ignoring the presence of economies to scale. The issue here is basically that: traditional analysis roughly assumes that the appropriate measure of household economic wellbeing is income or expenditures per capita. A further analysis finds a negative relationship between household size and expenditure per capita, inferring from this that larger households are poorer. However, this analysis is not valid if there are economies of scale in household production, so that a household's income needs grow more slowly than its increases in family size. Such economies of scale could exist because of the nature of food production, shelter provision and the existence of household public goods. Anand and Morduch find that even with modest economies of scale, household wellbeing is a positive rather than negative function of family size. They conclude from this that because of such scale effects in Bangladesh, adding children to households could be less costly than previously thought, and the impact of having more children on household poverty may be overstated.

Yet even if we assume that a relationship exists between larger household sizes and poverty, this would not immediately serve as evidence of a causal effect of household size on poverty. As Birdsall and Sinding (2001) point out, high fertility in poor households may simply reflect a conscious decision by households to tolerate high child costs today in return for increased old age security in the far-off future when these children are working and can support their parents. Thus an observed correlation between household size and poverty is not a causal effect of the former on the latter; rather they are both the simultaneous outcome of some deeper decision making process.

The decision may itself reflect the constraints that households face. For example, while a poor household may prefer to have fewer children who can be educated more intensively and thereby secure their retirement income from a smaller number of higher earning children rather than a higher number of lower earning children, this preferred choice for fewer but better educated children may be out of reach since households do not have the income to intensively educate children. Given that larger household sizes reflect a rational choice given social constraints, a well-meaning but simple-minded policy that compelled such households to have fewer children would make these households worse off: While such a policy might raise a household's current income, it would not ensure that parents can afford the higher education of their children, and thereby jeopardises the parents' old age security.

References

- Adams, R. 2003. "Economic growth, inequality, and poverty". World Bank Policy Research Paper No. 2972. The World Bank, Washington, D.C.
- Anand, S. and J. Morduch. 1996. *Population and the Poverty Problem: Evidence from Bangladesh*. Discussion Paper No. 559. Harvard Institute for International Development. Cambridge, Massachusetts.
- Becker, G. and H. Lewis. 1973. "On the interaction between quantity and quality of children". *Journal of Political Economy*, 81: S279–88.
- Birdsall, N. and S.W. Sinding. 2001. "How and why population matters: New findings, new issues". In N. Birdsall, A. Kelley and S. Sinding, eds., *Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World*. Oxford: Oxford University Press.
- Bloom, D., and D. Canning. 1999. "The health and wealth of nations:.. *Science*, 287: 1207–9.
- Bloom D., D. Canning and J. Sevilla. 2002. *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change*. Santa Monica, California: RAND, MR-1274.
- Blower, S., and P. Farmer. 2003. "Predicting the public health impact of antiretrovirals: Preventing HIV in developing countries". *AIDScience*, 3 (11). Accessed on 16 February 2009 at <http://aidsscience.org/Articles/AIDScience033.asp>.
- Boserup, E. 1981. *Population and Technological Change: A Study of Long-Term Trends*. Chicago: University of Chicago Press.
- Coale, A., and E. Hoover. 1958. *Population Growth and Economic Development in Low Income Countries: A Case Study of India's Prospects*. Princeton: Princeton University Press.
- Cutler, D., J. Poterba, L. Sheiner and L. Summers. 1990. "An Aging Society: Opportunity or Challenge?" *Brookings Papers on Economic Activity*, 1: 1–73.
- Deaton, A. 1999. "Comment". In A. Mason, T. Merrick and R. Shaw, eds., *Population Economics, Demographic Transition, and Development: Research and Policy Implications*. Washington, D.C.: The World Bank.
- Deaton, A. and C. Paxson. 2000. "Growth, demographic structure, and national savings in Taiwan". In Cyrus Chu and Ronald Lee, eds., *Population and economic change in East Asia*, supplement to *Population and Development Review*, 26: 141–73.
- Eastwood, R. and M. Lipton. 2001. "Demographic transition and poverty: Effects via economic growth, distribution, and conversion". In Birdsall et. al. (eds).
- Ehrlich, P. 1968. *The Population Bomb*. New York: Ballantine.
- Fry, M. and A. Mason. 1982. "The variable rate-of-growth effect in the life-cycle saving model". *Economic Inquiry*, 20, 426–41.
- Habakkuk, H. 1962. *American and British Technology in the Nineteenth Century*. Cambridge: Cambridge University Press.

- Higgins, M. 1998. "Demography, national savings, and international capital flows". *International Economic Review*, 39: 343–69.
- Higgins, M., and J. Williamson. 1997. "Age dynamics in Asia and dependence on foreign capital". *Population and Development Review*, 23: 261–93.
- Hurd, M. 1990. "Research on the elderly: Economic status, retirement, and consumption and saving". *Journal of Economic Literature*, 28: 565–637.
- Kelley, Allen C. and Robert M. Schmidt. 1995. "Aggregate population and economic growth correlations: The role of the components of demographic change". *Demography*, 32 (4): 543–55.
- Kelley, A. and R. Schmidt. 1996. "Savings, dependency, and development". *Journal of Population Economics*, 9: 365–86.
- Kuznets, S. 1967. "Population and economic growth". *Proceedings of the American Philosophical Society*, 111: 170–93.
- Lee, R., A. Mason and T. Miller. 2000. "Life cycle saving and demographic transition: The case of Taiwan". *Population and Development Review*, 26 (Suppl.): 194–222.
- Lee, R., A. Mason and T. Miller. 2001. "Saving, wealth, and population". In N. Birdsall, A. Kelley and S. Sinding, eds., *Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World*. Oxford: Oxford University Press.
- Leff, N.D. 1969. "Dependency rates and savings rates". *American Economic Review*, 59: 886–896.
- Lipton, M. 1983. "Demography and poverty". World Bank Staff Working Papers No. 623. The World Bank, Washington, D.C.
- Malthus, T.R. 1798. *Essay on the Principle of Population, As It Affects the Future Improvement of Society with Remarks on the Speculation of Mr. Godwin, M. Condorcet, and Other Writers*. Edited by Harmondsworth, 1982. New York: Penguin Classics.
- Mason, A. 1988. "Saving, economic growth, and demographic change". *Population and Development Review*, 14 (1): 113–44.
- Mason, A. 2001. "Population and economic growth in East Asia". In Andrew Mason, ed., *Population and Economic Growth in East Asia: Challenges Met, Opportunities Seized*, pp. 1–30. Stanford, California: Stanford University Press.
- Meltzer, D. 1992. "Mortality decline, the demographic transition, and economic growth". PhD dissertation, University of Chicago, Department of Economics, December.
- Merrick, T. 2001. "Population and poverty in households: A review of reviews". In N. Birdsall, A. Kelley and Sinding, eds., *Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World*. Oxford: Oxford University Press.
- Population Council. 1995. "Why women who don't want to get pregnant don't use contraception". *Population Briefs*. 1 (2, June): 5.

- Pritchett, L. 1999. "Comment". In Andrew Mason, Thomas Merrick and Paul Shaw, eds., *Population Economics, Demographic Transition, and Development: Research and Policy Implications*. Washington, D.C.: The World Bank.
- Romer, D. 1996. *Advanced Macroeconomics*. New York: McGraw-Hill.
- Salomon, J., D. Hogan, J. Stover, K. Stanecki, N. Walker, P. Ghys and B. Schwartlander. 2005. "Integrating HIV prevention and treatment: From slogans to impact". *PLoS Med*, Jan 2 (1): e16 doi:10.1371/journal.pmed.0020016.
- Schultz, T. 2004. "Demographic determinants of savings: Estimating and interpreting the aggregate association in Asia". IZA Discussion Paper No. 1479. Yale University Economic Growth Center Discussion Paper 901. Accessed on 16 February 2009 at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=639187.
- Simon, J. 1986. *Theory of Population and Economic Growth*. New York: Blackwell.
- Simon, J. 1981. *The Ultimate Resource*. New Jersey: Princeton University Press.
- Solow, R. 1956. "A contribution to the theory of economic growth". *Quarterly Journal of Economics*, 70: 65–94.
- UNFPA. 1999. *6 Billion – A Time for Choices, The State of World Population*. New York: United Nations Population Fund.
- United Nations. 2002. *World Population Prospects 2000 CD-Rom*. New York: United Nations.
- Wattenberg, B. 1987. *The Birth Dearth*. New York: Pharos Books.
- Webb, S. and H. Zia. 1990. "Lower birth rates = Higher savings in LDCs". *Finance and Development*, 27: 12–4.
- World Health Organisation and UNAIDS. 2007. "WHO/UNAIDS Technical Consultation on Male Circumcision and HIV Prevention: Research Implications for Policy and Programming, Conclusions and recommendations". Downloaded on 16 February 2009 from http://data.unaids.org/pub/Report/2007/mc_recommendations_en.pdf.

Realising the Demographic Dividend: Is Africa Any Different?

David E. Bloom, David Canning, Günther Fink and Jocelyn Finlay

Because people's economic behaviour varies at different stages of life, changes in a country's age structure can have significant effects on its economic performance. Nations with a high proportion of children are likely to devote a high proportion of resources to their care, which tends to depress the pace of economic growth. The effects are similar if a large share of resources is needed by a relatively less productive segment of the elderly. By contrast, if most of a nation's population falls within the working ages, output per capita will be high all other factors being equal.

As countries move through the demographic transition from a high fertility and high mortality to a low fertility and low mortality equilibrium, the size of the working age population mechanically increases. This can create virtuous cycles of economic growth commonly referred to as the "demographic dividend". Bloom *et al.* (2003) explore this concept of the demographic dividend in detail and compare the variation in the age distribution across countries and regions.

Less developed countries, where fertility rates are generally high and life expectancy low, have a large proportion of their population in the younger age groups. More developed countries have lower fertility rates and higher life expectancy and thus a large proportion of their population is at higher ages. Lee (2003) and Weil (1999), respectively, examine the projected demographic transition and the effect of this transition on economic outcomes. While most regions around the world are evolving through the demographic transition Africa stands as an outlier. Fertility rates on the continent remain high and are declining only slightly, while life expectancy is actually falling in some countries as a result of the impact of HIV/AIDS. Given these trends, Bongaarts and Bulatao (1999) have argued that sub-Saharan African countries are not likely to earn the demographic dividend. We draw a more differential picture for sub-Saharan Africa, and present a positive outlook for those countries with the right set of institutions in place.

The goal of this chapter is to test whether the determinants of growth in general, and the effects of demography in particular, are different in Africa than in the rest of the world. We indicate that most sub-Saharan countries have the potential to reap the benefits of the demographic dividend, but that solid institutional settings are a prerequisite. Lee *et al.* (2006), Bloom *et al.* (2003) acknowledge the ineffectiveness

of the demographic transition in realising the demographic dividend when quality institutions are not in place. We refer to institutions as a general term to include rule of law, efficiency of the bureaucracy, corruption, political freedom and expropriation risk, openness (political system, trade barriers, and black market premium), freedom of political representation, and freedom of speech. Besides this list of benchmarks that we capture in the institutions measure, a broader framework would include infrastructure (health care systems, schooling, roads, and transport) and a formal labour market with unions and laws protecting both employees and employers.

The Impact of the Policy and Institutional Environment

Without the right policy environment, countries will be too slow to adapt to their changing age structure and, at best, will miss an opportunity to secure high growth. At worst, where an increase in the working-age population is not matched by increased job opportunities, countries will face costly penalties, such as rising unemployment and perhaps also higher crime rates and political instability. When no policies are in place to provide for the rising numbers of the elderly, many people will face destitution in their final years. Having a larger, healthier and better-educated workforce will only bear economic fruit if the extra workers can find jobs. Solid institutions that can gain the confidence of the population and the markets alike may help countries to reap the potential benefit created by their demographic transition.¹

Poor rule of law discourages investment as contracts are not reliably enforceable. Corruption and an inefficient bureaucracy create difficulties and uncertainties in establishing an enterprise or gaining and maintaining employment. The lack of political freedom and high expropriation risk lead to short-sighted behaviour and undermine long-term investment. Thus, a poor institutional environment critically affects the potential gains from the demographic transition.

A healthy degree of flexibility in labour markets is also vital if a country is to accommodate a burgeoning working-age population. Flexibility means that employers are able to expand and contract their businesses rapidly, to shift workers from one area of the business to another, and to raise and lower pay more easily. Flexibility also means a workforce that is able to adapt its working patterns as the business environment shifts. Flexibility can be difficult to sell to a workforce, as employers are commonly thought to reap the benefits while employees bear the costs. However, the provision of adequate safety nets and generous retraining programmes can help persuade workers to become less risk-averse. Although recent history indicates that designing and implementing effective programmes along these lines is a challenging task in low- and middle-income countries, the incentives for proceeding in this direction are substantial. Many wealthy industrial countries have successful programmes that provide a good starting point for thinking both conventionally and imaginatively along these lines.

The difficulty in changing institutions (both those related to labour flexibility and many others) must not be underestimated. In the example of labour flexibility, it is likely that not only will changes be widely resisted but that the substantial incentives for action will be unlikely to carry the day, since the requisite compensatory measures for the losers in any such reform would be so costly. Thus, pointing out the importance of institutional change is quite different from showing whether such change is possible, economically, socially and politically. Addressing this matter is worthy of a great deal of further attention but is certainly beyond the scope of this chapter.

A comparison of key economic and demographic statistics of the sub-Saharan African countries with those of the rest of the world (ROW) highlights the particularity of the region. Given these structural differences, it is not clear whether African countries follow the global growth dynamics. Sachs and Warner (1997b) find that the determinants of economic growth in Africa are no different from those for the rest of the world. Moreover, they find that the lack of openness and poor economic policies are at the root of Africa's dismal economic performance within the 1965–1990 sample periods they use. Since the publication of the Sachs and Warner (1997) article, many African countries, such as Mali, South Africa, Niger, Mozambique, Cameroon, Madagascar and Uganda, have improved their institutional quality, and fertility rates in many African countries have begun to fall, potentially initiating the demographic transition.

Despite some recent decreases, however, fertility rates in many African countries remain high relative to those of the rest of the world. There are various reasons for high fertility. With limited financial infrastructure in rural areas offering little incentive or means to save, children are still viewed as insurance against the vagaries of old age. They are also a key source of labour. Furthermore, and despite medical advances, infectious disease is still widespread, particularly in rural areas, so cultural norms and policies encouraging high fertility in order to achieve desired family sizes (such as child fostering, polygamy and the distribution of land according to family size) are changing only slowly.

In the last 40 years, Africa has faced a series of prolonged and debilitating wars. Wars not only kill and injure soldiers and civilians alike; they also destroy infrastructure and social structures, thus destroying the foundation on which the demographic transition can be of benefit to the economy.

Another aspect of the problems facing sub-Saharan Africa is the prevalence and virulence of infectious diseases. Despite some impressive health gains over the last century, malaria, HIV/AIDS and tuberculosis (TB) are just three of the big killers that are not yet successfully controlled. Malaria and AIDS alone currently account for 3 million to 4 million of sub-Saharan Africa's roughly 10 million annual deaths. HIV is particularly prevalent in sub-Saharan Africa, where many countries have ten or more people living with HIV for each person who has already died from the

disease. In 2007, sub-Saharan Africa accounted for 67 per cent of all people living with HIV and for 75 per cent of AIDS deaths (UNAIDS, 2008).

Furthermore, in addition to children and the elderly as dependents, many otherwise productive adults are suffering the ravages of HIV. Heterosexual sex is the dominant means of transmission, and the majority of people dying of AIDS are between 20 and 59 years of age. In other words, it is a disease that particularly hits those who should be economically productive, and threatens not only health, but also the economic stability and potential of a country. It also diverts needed manpower away from productive labour to care for those who are sick.

Despite the long list of challenges to be faced, our outlook on economic growth in sub-Saharan countries over the next 20 years is rather positive. Given our past estimates of economic growth, current institutional settings and demographers' population forecasts, we argue that Ghana, Côte d'Ivoire, Malawi, Mozambique and Namibia have a very high potential to profit from the demographic dividend over the next 20 years. Our growth outlook is also very positive for South Africa and Botswana as current regional leaders in terms of their institutional quality, even though their prospects for profiting from a demographic dividend over the next two decades are rather small.

Senegal, Cameroon, Tanzania, Togo and Nigeria are projected to have a very strong growth of the share of the working age population, but still suffer from institutional deficiencies. Given the importance of institutional quality as a catalyst for converting the growth of the working age share into a demographic dividend, it is hard to tell the degree to which these countries will be able to gain from the demographic dividend.

Empirical Strategy

In this section we explain the model and data used to identify whether the determinants of economic growth are different in sub-Saharan Africa compared to the rest of the world. Then, we decipher the role of institutions coupled with the demographic transition that can lead to a realisation of the demographic dividend. We then use projections of the growth of the working age share to identify which countries stand to benefit from the demographic dividend. In the last section of the paper we discuss the results and provide conclusions.

Our empirical strategy consists of three parts. In the first part of the empirical section, we estimate the basic relation between demography and economic growth. Denoting income by Y and the total population by P we can express output per capita as:

$$\frac{Y}{P} = \frac{Y}{WA} \frac{WA}{P} \quad (1)$$

where WA is the number of working age people. Taking logs

$$y = \log \frac{Y}{P}, \quad z = \log \frac{Y}{WA}, \quad w = \log \frac{WA}{P} \quad (2)$$

We can express the steady state level of income per capita as

$$y^* = z^* + w = \beta x + w \quad (3)$$

where x is the matrix containing the variables determining steady state income per working age person. Following Barro and Sala-i-Martin (2003) economic growth occurs as each country converges from its initial position to its steady state. In our case, this is conditional on the variables x and w , so that growth in every period is given by:

$$\Delta y^* = \lambda(y^* - y_{-1}) = \lambda(\beta x + w - y_{-1}) \quad (4)$$

The steady state determines the end of period equilibrium of the economy and can change during the growth period considered. Let us suppose that we can write a structural model as:

$$x = \alpha_1 x_{-1} + \alpha_2 w + \alpha_3 y, \quad w = \gamma_1 x + \gamma_2 w_{-1} + \gamma_3 y \quad (5)$$

Then we can derive the reduced form

$$\Delta y = \lambda(y^* - y_{-1}) = \delta_1 x_{-1} + \delta_2 w_{-1} + \delta_3 y_{-1} \quad (6)$$

where the reduced form coefficients δ are combinations of the structural coefficients from equations 0.7 and 0.9. Taking five-year growth rates as our dependent variable we first estimate a standard growth model as described in Equation 0.9 for the full sample of countries. In a second step, we divide our sample into sub-Saharan and non sub-Saharan countries, and test whether there are significant differences in the estimated coefficients.

In the second part of the empirical section, we use the estimated coefficients in combination with population forecasts from the United Nations to gauge the magnitude of the demographic dividend in sub-Saharan countries over the coming 20 years.

We use a five-year panel covering the years 1960 to 2000. We limit our data set to those countries where all explanatory variables are available, which leaves us with a sample of 85 countries, out of which 19 are located in the sub-Saharan zone.² We then use our estimates for out-of-sample economic growth projections using an extended set of countries.

Data on national income are from the Penn World Tables mark 6.2; those on working-age share are from the United Nations' World Population Prospects 2004. We add additional variables from different data sources: schooling data are from Barro and Lee (2000), life expectancy from the World Development Indicators (World Bank, 2006), ethnic fractionalisation data from Alesina *et al.* (2003), and institutional quality data from Knack and Keefer (1995), Sachs and Warner (1997a), Wacziarg and Welsh (2003), and the World Bank (2007).

In Table 9.1, we provide separate descriptive statistics for sub-Saharan countries and the rest of our sample (which we refer to as rest of the world or ROW). Pronounced differences are visible across all dimensions.

Table 9.1: Descriptive statistics by subsamples

Variable	Sub-Saharan countries			Non sub-Saharan countries		
	Obs.	Mean	Std. dev.	Obs.	Mean	Std. dev
Year	124	1985	10.6	486	1983	11.2
GDP per capita	124	1850	1760	486	9393	7348
5-year growth in GDP per capita	124	.026	.229	486	.116	.136
Openness	124	.209	.409	486	.591	.492
Institutions	124	19.47	4.60	486	26.25	7.62
Ethnic fractionalisation	124	.728	.141	486	.336	.224
Landlocked	124	.395	.491	486	.078	.269
Tropical	124	.916	.242	486	.388	.460
Average years of schooling	124	2.29	1.55	486	5.72	2.76
Life expectancy	124	48.74	7.15	486	68.41	7.91
Working age share	124	51.63	2.71	486	59.67	6.14
Growth in working age share (5 yr)	124	.001	.019	486	.014	.024

The average income per capita in sub-Saharan countries over the sample period was US\$1,850, and the average annual growth rate a bleak 0.5 per cent per year. Compare this with the average income of US\$9,393 and an average growth rate of 2.3 per cent for the rest of the world.³ The result is a rather bleak picture of average sub-Saharan economic development over the last decades. The differences between sub-Saharan countries and the rest of our sample are visible across all explanatory variables typically applied in growth regressions: on average, sub-Saharan countries display significantly lower levels of schooling and life expectancy, have poorer institutions, higher degrees of ethnic fractionalisation, and a lower degree of openness. They also have a higher chance of being landlocked and in a tropical zone than the average non sub-Saharan country in our sample.

Most importantly for the purpose of this paper, the average working-age share of the total population is 8 percentage points lower in sub-Saharan countries than in the rest of the world, with the average growth rate of the being close to zero over the sample period.

Estimating the Demographic Dividend

We start by estimating the basic growth model outlined above. To capture different steady-states across countries, we introduce an extended set of control variables, including institutional quality, ethnic fractionalisation, schooling, life expectancy, and two dummy variables that indicate whether a country lies in a tropical zone and is landlocked. The main variables of interest are growth and the log of the size of the working-age population (*WAS*).

The main results are summarised in Table 9.2.

Table 9.2: Economic growth and the demographic dividend

	Dependent variable: 5 year economic growth rate			Wald test1
	(1)	(2)	(3)	
Openness	0.036** (2.37)	0.026 (1.52)	0.018 (1.00)	1.43 (0.23)
Institutions	0.006*** (3.36)	0.007*** (3.38)	0.005*** (2.61)	0.02 (0.88)
Ethnic fractionalisation	-0.064*** (2.64)	-0.068*** (2.66)	-0.080*** (3.02)	1.55 (0.21)
Landlocked country	0.005 (0.28)	0.016 (0.88)	0.013 (0.72)	0.66 (0.42)
Tropical country	-0.007 (0.37)	-0.006 (0.28)	-0.005 (0.28)	2.38 (0.12)
Avg. years of schooling	-0.007 (1.61)	-0.007 (1.57)	-0.008 (1.62)	0.05 0.82
Life expectancy	0.007*** (4.82)	0.006*** (3.79)	0.007*** (4.00)	2.00 (0.16)
Initial GDP	-0.117*** (5.29)	-0.128*** (5.44)	-0.130*** (5.51)	3.21* (0.07)
Log (working age share)	0.378*** (3.59)	0.540*** (4.64)	0.505*** (4.23)	0.19 (0.67)
Growth in WAS	0.804*** (2.94)	1.538*** (3.20)	-2.002 (1.02)	0.43 (0.51)
Growth in WAS *institutions			0.139** (1.98)	0.40 (0.53)
Constant	-0.919** (2.30)	-1.437*** (3.30)	-1.299*** (2.88)	0.00 (0.96)
Time fixed effects	Yes	Yes	Yes	Chow Test:
Country fixed effects	No	No	No	49.85***
Estimation	OLS	2SLS	2SLS	(0.00)
Sample	Full sample	Full sample	Full sample	Full sample
Observations	610	554	554	554
R-squared	0.32	0.37	0.37	0.37

Notes: Robust t statistics in parentheses.

* Significant at 10 per cent; ** Significant at 5 per cent; *** Significant at 1 per cent.

Wald test H0: Coefficient identical for sub-Saharan subsample and noN sub-Saharan sample. We report the chi2 statistics, with p-values in parentheses.

In column 1, we estimate our basic model with OLS. Out of the set of control variables, our measures of institutional quality, life expectancy and ethnic fractionalisation appear to have the most significant effect on growth. The lagged level of income enters with a negative and highly significant coefficient, consistent with our basic convergence assumption. As to the demographic variables, our results strongly confirm our priors: both the level of the working age share and its growth enter the growth equation with a positive and highly significant sign.

The negative and non-significant effect of schooling is orthogonal to our prior. We try alternative specifications where we interact the schooling variable with institutional quality and growth of the working age share per cent without different results. One possible explanation for the insignificance of schooling in our empirical work may be measurement error in the schooling data. Another explanation may lie in the high degree of collinearity in the data; the correlation between initial income, initial life expectancy and institutional quality are all larger than 0.75.

To control for the interdependence of the growth in working-age share and economic growth, we use an instrument for the growth in working age share in columns 2 and 3 of the table. The instrument we use is lagged growth in *WAS*, which works well as a predictor of *WAS* growth due to the slow moving character of the variable, and can be considered predetermined in the main equation. As indicated in column 2 of Table 9.2, the IV estimates on the growth in working-age share are significantly larger than the ones obtained by OLS. This could reflect measurement error, or may be interpreted as evidence for a negative causal effect from economic growth to the growth in *WAS*.

In column 3, we test whether the positive growth effects of the demographic dividend are conditional on the institutional quality of a country as suggested by Bloom and Canning (2003); our results strongly confirm this hypothesis. Interacting the growth in working-age population with institutional quality, we find the interaction term to have a positive and highly significant effect, while the growth in working-age share itself is no longer significant. This is an important result, as it implies that only countries featuring high institutional quality are able to receive a demographic dividend. The estimated size of the institutional effect on growth is large. Taking a non sub-Saharan country with an average growth of working-age population (0.014), a two-standard-deviation increase in institutional quality (15.2) increases economic growth by about 2 per cent per year. Three-quarters of this effect is due to the direct effect of institutions on growth; one quarter, or half a per cent growth per year, is due to the interaction of institutions with the growth in the working-age share.

Given the strong differences between sub-Sahara and ROW, one may question the applicability of this basic result to the sub-Saharan region, and argue that sub-Saharan countries follow different patterns. To test this hypothesis, we separately estimate the model specified in column 3 for the two subsamples, and test whether

the estimated coefficients differ significantly between the two subsamples. We perform both Wald tests for each single coefficient being the same across sample, and a Chow test for all coefficients being the same across the two samples. The results of this test are displayed in the last column of Table 9.2. According to our analysis, the coefficient on initial GDP per capita is the only one significantly different across samples. The absolute value of the coefficient on initial GDP is higher in sub-Saharan Africa than the rest of the world, implying more rapid income convergence in this region. For all other variables, the null hypothesis of equal coefficient cannot be rejected at standard confidence intervals.

Implications

Two main results emerge from our empirical analysis: First, the effects of demographic change on economic growth are sizeable, but contingent on good institutions. Second, the estimated relationship between demographic variables and economic growth appears to be constant across samples, and thus to apply to sub-Saharan countries as much as to any other country in the world. A closer look at the sub-Saharan countries in our sample confirms this finding. As indicated in Figure 9.1, the relationship between demographic developments and economic growth over the last 20 years appears quite robust. With the exception of Uganda and Mali, which indicated high growth rates despite negative growth in the working-age share due to excellent policy reforms, all countries with positive economic growth rates have also observed positive growth rates in their working-age population.

Figure 9.1: Growth in working age share and economic growth 1980–2000

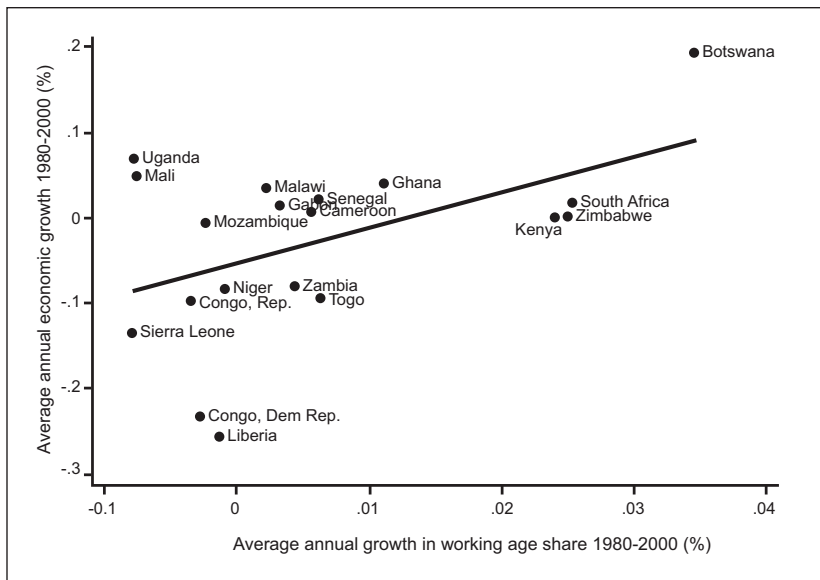


Table 9.3: Institutional development: Sub-Saharan countries

Country	ICRG score (1982-1997, avg.)	Polity ¹ score	Business environment rank ²	Sachs Warner openness ³	Average ranking within SSA group ⁴
South Africa	28.57	9	29	1	1.25
Botswana	27.21	9	48	1	2
Namibia	23.8	6	42	-	7.75
Côte d'Ivoire	23.86	4	141	1	8
Mozambique	21.64	6	140	1	8
Ghana	19.98	2	94	1	8.25
Kenya	22.28	-2	83	1	8.75
Madagascar	17.65	7	149	1	11.25
Malawi	20.47	7	110	0	11.5
Gambia, The	23.08	-5	132	1	12.5
Niger	19.96	4	160	1	13.25
Gabon	22.14	-4	31	0	13.75
Senegal	19.18	8	146	0	14
Cameroon	21.87	-4	152	1	14.25
Ethiopia	17.84	1	97	0	14.75
Mali	12.4	6	155	1	14.75
Tanzania	21.27	2	142	0	14.75
Nigeria	16.11	4	108	0	15.5
Uganda	14.99	-4	107	1	15.5
Guinea	19.54	-1	157	1	15.75
Zambia	17.21	1	102	0	15.75
Guinea-Bissau	13.62	5	173	1	17
Burkina Faso	19.22	-3	163	1	17.5
Liberia	8.98	0	-	0	19.75
Somalia	12.06	0	-	0	19.75
Togo	17.67	-2	151	0	20
Zimbabwe	20.57	-5	153	0	20
Angola	17.75	-3	156	0	21.5
Sierra Leone	16.05	0	168	0	23
Congo, Dem. Rep.	9.84	0	175	0	24.75
Sudan	11.96	-7	154	-	25.25
Congo, Rep.	16.99	-6	171	0	25.5
Non-sub-Saharan	25.39	3.88	80	0.78	-
United States	36.25	10	3	1	-

Notes: 1. Source: The Polity IV Project, <http://www.cidcm.umd.edu/polity/>. Reference year is 2000. 2. The World Bank Business Environment database. <http://www.doingbusiness.org/>. Reference year is 2005. 3. Source: Wacziarg and Horn Welsh (2003). Openness measure reflects the average score 1990 to 1999. 4. Average ranking in columns 2–5.

What are the implications for the growth prospects in sub-Saharan countries? Given our results, the answer to this question depends on two country-specific factors: future developments in population structure and institutional quality. Institutional quality is hard to define, and even harder to measure; to provide the most complete measure possible, we display four different measures of institutional quality in Table 9.3. Column 1 indicates the average combined score each country reached in the International Country Risk Guide over the period 1982–1997 (Knack and Keefer, 1995). The total score is the aggregation of the scores of five different subcategories: rule of law, efficiency of the bureaucracy, government stability, and corruption and expropriation risk. Column 2 indicates the institutional quality measure as determined by the Polity IV project. The score ranges from -10 (worst) to +10 (best). Column 3 indicates the position of each country in the World Bank's recent business environment ranking (World Bank, 2007). The ranking is based on business surveys, and measures the general difficulty of doing business in a country.

Column 4 indicates the latest version of the openness variable originally introduced by Sachs and Warner (1997a), and updated by Wacziarg and Welsh (2003). A country is considered closed if average tariff rates are above 40 per cent, non-tariff barriers cover 40 per cent or more of trade, black market exchange rates depreciated by 20 per cent or more relative to the official exchange, if the country has a state monopoly on major exports, or the country has a socialist economic system. Although there is some variation in the absolute rankings, the relative position of countries appears relatively similar across the categories. South Africa, Namibia and Botswana appear to have the best institutions independent of the measure applied, while Sudan and the Republic of the Congo get the worst evaluations.

To get a simple measure of a country's overall evaluation, we indicate the average ranking (among sub-Saharan countries in our sample) in the four categories in column 5. The lower the aggregate score, the better the overall evaluation of the country's institutions, and the more positive is thus the growth outlook for the given country. Cohort specific population growth rates are calculated on a regular basis by the United Nations and published in the World Population Prospects (2004). Table 9.4 summarises the forecasts for the intermediate growth scenario. Column 2 of Table 9.4 indicates the current share of the working age population, while columns 3 and 4 indicate the expected growth in working age population share over the period 2005–2015 and 2005–2025, respectively. The countries with the highest expected growth in working age share are Senegal, Cameroon, Tanzania; the countries with the lowest rates are Botswana and South Africa, whose working age population is expected to grow only very moderately over the next 20 years. In the last column, we indicate the aggregate institutional score. Quite strikingly, the five countries with the highest expected rate of growth of working-age share are all characterised by medium to low quality institutions. The countries that do relatively well on both dimensions are Madagascar, Côte d'Ivoire, Ghana and Namibia, which are thus most likely to earn the demographic dividend.

Table 9.4: Forecasted growth in the working age population: institutional ranking

Country	Working-age share 2000 ¹	Average annual WAS growth ² 2005–2015	Average annual WAS growth ² 2005–2025 ²	Average institutional ranking ³
Senegal	52.19	0.64	0.68	14
Cameroon	53.54	0.66	0.63	14.25
Tanzania	52.94	0.59	0.62	14.75
Togo	52.39	0.55	0.62	20
Nigeria	51.76	0.52	0.59	15.5
Madagascar	52.17	0.58	0.57	11.25
Côte d'Ivoire	53.72	0.57	0.56	8
Gabon	53.51	0.77	0.54	13.75
Gambia, The	55.34	0.46	0.52	12.5
Sudan	56.18	0.51	0.52	25.25
Ghana	55.37	0.54	0.51	8.25
Namibia	53.09	1.06	0.51	7.75
Ethiopia	51.62	0.48	0.50	14.75
Malawi	50.81	0.45	0.46	11.5
Zambia	50.67	0.38	0.46	15.75
Mozambique	52.61	0.40	0.45	8
Mali	48.8	0.35	0.44	14.75
Burkina Faso	48.65	0.33	0.43	17.5
Guinea	52.66	0.26	0.41	15.75
Kenya	53.1	0.04	0.39	8.75
Somalia	53.38	0.19	0.36	19.75
Zimbabwe	54.09	0.50	0.35	20
Niger	49.02	0.22	0.27	13.25
Angola	50.52	0.19	0.26	21.5
Uganda	47.08	-0.03	0.20	15.5
Congo, Rep.	50.39	-0.02	0.18	25.5
Congo, Dem. Rep.	50.23	-0.12	0.15	24.75
Guinea-Bissau	50.07	-0.04	0.14	17
Sierra Leone	53.95	0.00	0.14	23
Liberia	50.86	-0.15	0.07	19.75
Botswana	58.13	0.25	0.05	2
South Africa	62.84	0.09	0.02	1.25
US	66.10	-0.11	-0.25	
Non sub-Saharan	63.37	0.24	0.07	

Notes:

1. Fraction of the population in the age group 15–64. World Population Prospects 2004.
2. Forecast from World Populations Prospects 2005, medium scenario.
3. Average ranking within sub-Saharan countries; see previous table.

Discussion and Conclusion

The descriptive statistics in Table 9.1 illustrate the dismal economic, social and geographic predicament of Africa compared with the rest of the world. Current GDP per capita amounts to one-fifth of that in ROW, average years of schooling are at 40 per cent of ROW levels, and average life expectancy is 20 years lower. Moreover, the average institutional quality in Africa lags significantly behind the average in ROW. Given this pronounced lag one might argue that Africa is simply different from ROW and claim that the factors determining economic development in Africa diverge from those of ROW. We find no evidence for this claim. Our results imply that the standard economic growth model equally applies to sub-Saharan countries as it does to other regions in the world in general and with respect to the demographic dividend in particular.

As discussed in the introduction, the demographic transition from high fertility and low life expectancy to low fertility and high life expectancy does not guarantee a demographic dividend. A stable and transparent political and economic environment is required for individuals in the working-age population to be productive. Efficiency losses stemming from poor institutional quality will outweigh any gains that a high proportion of working-age population can bring. Our results reveal that the demographic transition does have an effect on economic growth, but only when coupled with institutional quality.

From a demographic perspective, the prospects for earning the demographic dividend and spur economic growth look good. As indicated in Table 9.4, the United Nations predicts significant increases in the working age share for close to all countries in the sub-Saharan region. Africa stands on the cusp of the demographic transition, but good institutions will be needed to earn the demographic dividend. As of today, our results make us most optimistic for Ghana, Côte d'Ivoire, Malawi, Mozambique and Namibia, which have done relatively well on the institutional side and have significant increases in working age share coming up over the next 20 years. Cameroon, Nigeria, Senegal, Tanzania and Togo have the greatest potential for increased economic growth from a demographic point of view, but will most likely have to improve their institutional framework significantly to fully reap the demographic dividend.

Notes

1. We stress that changes in population age structure do not automatically promote economic growth. In the absence of policies that successfully facilitate the absorption of considerable numbers of people into productive employment, large cohorts of working-age people can impede economic growth and be socially and politically destabilising, a “demographic penalty” of sorts. In practice, this may well be a significant factor for some countries in slowing the pace of economic growth. Moreover, it is precisely in the countries that have long had slow economic growth that rapid institutional improvement would be most difficult and therefore these countries may be the ones most likely to experience a demographic penalty.

2. For a full list of countries, please see the Appendix.
3. Note that the economic growth figures are five-year averages.

References

- Alesina, A., A. Devleeschauwer, S. Kurlat and R. Wacziarg. 2003. "Fractionalisation". *Journal of Economic Growth*, 8: 155–94.
- Barro, R.J. and J.-W. Lee. 2000. "International data on educational attainment: Updates and implications." *Oxford Economic Papers*, 53 (3): 541–63.
- Barro, R. and X. Sala-i-Martin. 2003. *Economic Growth*. Cambridge, Massachusetts: MIT Press.
- Bloom, D.E., D. Canning and J.P. Sevilla. 2003. *The Demographic Dividend: A New Perspective on the Economic Consequences of Population Change* Santa Monica, California: RAND, MR-1274.
- Bongaarts, J. and R.A. Bulatao. 1999. "Completing the demographic transition". *Population and Development Review*, 25 (3): 515–29.
- Knack, S. and P. Keefer. 1995. "Institutional and economic performance: Cross-country tests using alternative measures". *Economics and Politics*, 7 (3): 207–27.
- Lee, R. 2003. "The demographic transition: Three centuries of fundamental change". *Journal of Economic Perspectives*, 17 (4): 167–90.
- Lee, R., S.-H. Lee and A. Mason. 2006. "Charting the Economic Life Cycle." NBER Working Paper No. 12379. National Bureau of Economic Growth, Cambridge, Massachusetts.
- Sachs, J. and A. Warner. 1997a. "Fundamental sources of economic growth". *American Economic Review*, 6 (3): 335–76.
- Sachs, J. and A. Warner. 1997b. "Sources of slow growth in African economies". *Journal of African Economies*, 6: 335–37.
- UN. 2004. *World Population Prospects*. CD-ROM.
- UNAIDS. 2008. *Report on the Global HIV/AIDS Epidemic 2008*. Geneva, Switzerland: United Nations Joint Programme on HIV/AIDS.
- Wacziarg, R. and K.H. Welch. 2003. "Trade liberalisation and growth: New evidence". NBER Working Paper No. 10152. National Bureau of Economic Growth, Cambridge, Massachusetts.
- Weil, D.N. 1999. "Population growth, dependency, and consumption". *American Economic Review*, 89 (2): 251–55.
- World Bank. 2006. "World Development Indicators". CD-ROM. The World Bank, Washington, D.C.
- World Bank. 2007. "Doing Business database". <http://www.doingbusiness.org/>. Retrieved 21 June 2008.

Appendix

Sub-Saharan Sample Country List

Botswana, Cameroon, Congo (Dem. Rep.), Congo (Rep.), Gambia, Ghana, Kenya, Liberia, Malawi, Mali, Mozambique, Niger, Senegal, Sierra Leone, South Africa, Togo, Uganda, Zambia, Zimbabwe.

Non-Sub-Saharan Sample Country List

Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, Bolivia, Brazil, Canada, Chile, China, Colombia, Costa Rica, Cyprus, Denmark, Dominican Republic, Ecuador, Egypt (Arab Rep.), El Salvador, Finland, France, Greece, Guatemala, Haiti, Honduras, Hungary, Iceland, India, Indonesia, Iran, Islamic Rep., Ireland, Israel, Italy, Jamaica, Japan, Jordan, Korea, Rep., Malaysia, Malta, Mexico, Netherlands, New Zealand, Nicaragua, Norway, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Portugal, Singapore, Spain, Sri Lanka, Sweden, Switzerland, Syrian Arab Republic, Thailand, Trinidad and Tobago, Tunisia, Turkey, United Kingdom, United States, Uruguay, Venezuela.

Reproductive Health Behaviour, HIV/AIDS and Poverty in Africa

Peter Glick

Few would disagree with the statement that of all the issues touching on both demography and economics in Africa, the AIDS epidemic is the most pressing for research and policy. Sub-Saharan Africa is by far the region worst affected by the epidemic. An estimated 24.7 million adults in Africa¹ are infected with the human immunodeficiency virus (HIV), the virus that causes AIDS – accounting for two-thirds of all adults with HIV globally (UNAIDS, 2007). While the number of new infections has declined since 2001, some 1.7 million adults and children in Africa became infected in 2007. Prevalence among adults – the share of the adult population estimated to be HIV positive – averages about 6 per cent across the region but there is wide variation both in prevalence levels and in trends. Prevalence is generally stable and relatively low (under 5 per cent) in West Africa and stable or declining in much of East Africa, but at higher rates (over 6 per cent in Uganda, Kenya and Tanzania). In most countries of Southern Africa, prevalence is extremely high – over 15 per cent in Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland and Zimbabwe – and generally is only now beginning to peak.

This chapter considers the complex linkages between poverty, reproductive health and behaviours, and HIV/AIDS in Africa. It addresses the following questions: What have we learned to date about these links and what are the gaps in knowledge to be addressed by further research? What is known about the effectiveness for HIV prevention of reproductive health and HIV/AIDS interventions and policies in Africa? What are the appropriate methodological approaches to research on these questions? With regard to the last question, an effort is made to assess what can be learned both through new data collection and from existing sources such as Demographic and Health Surveys, which have been carried out in many African countries.

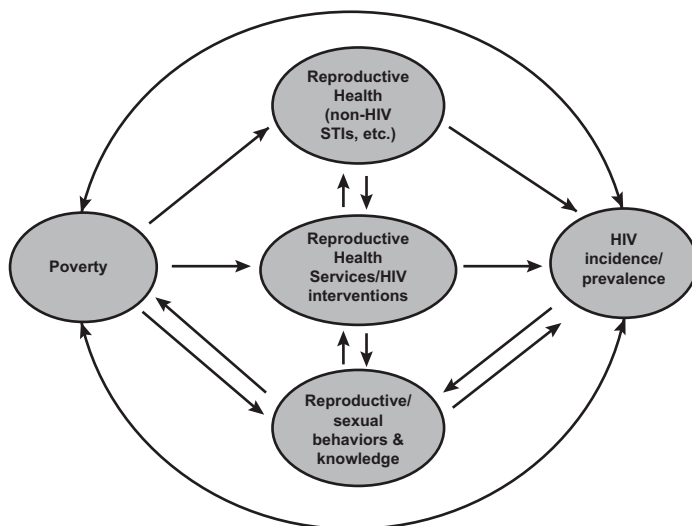
Some Definitions

A few definitions are in order. The WHO definition of reproductive health is a state of physical, mental, and social well-being in all matters relating to the reproductive system at all stages of life (WHO, 2004). Corresponding to this broad definition of

reproductive health, which was explicitly intended to incorporate sexual health, we take a broad view as to what constitutes reproductive health *services* (RHS). This will obviously include traditional family planning and maternal and antenatal care. But it also will include programmes and services such as control of non-HIV sexually transmitted infections (STIs); HIV prevention, testing and treatment; condom distribution and promotion; and efforts to promote and provide circumcision to men. For the purposes of this chapter we can hardly ignore this second group of programmes, which are all related in varying degrees to HIV prevention. Further, there is an ongoing debate over the advisability in the African context of integrating STI/HIV prevention and care into existing reproductive health services; for this reason, too, it is pertinent to consider the full range of programmes related to reproductive and sexual health. In a similar vein, the relevant *behaviours* for this discussion must include not just behaviour explicitly related to demographic decisions (fertility and contraception, age at marriage), but also, clearly, sexual risk behaviours.

Figure 10.1, provides an overview of the interactions between poverty, reproductive health (and reproductive health services and related behaviours and knowledge) and HIV/AIDS. The links are many and complex, with numerous possible feedback effects. To take one important example of the latter, patterns of sexual behaviour such as unprotected sex with casual partners obviously affect HIV incidence and prevalence,² but these behaviours may also change in response to recognition of HIV and the risks associated with it. Note as well that most of these processes and outcomes have both micro (individual) level and macro (population) level dimensions: individual HIV status and HIV prevalence rates, individual incomes or poverty, and GDP growth or poverty rates, and so on.

Figure 10.1: Inter-relationships between poverty, reproductive health and HIV/AIDS



The rest of the chapter is taken up with consideration of the key linkages portrayed in the figure: what we know about them, what we need to learn and what is required for this learning to take place. We begin the next section with Figure 10.1: the connections of reproductive health, reproductive and sexual health services (including HIV interventions), and behaviours, both with each other and with HIV/AIDS. A good deal of this section will consider the evidence regarding the impacts of HIV interventions on behaviours and HIV incidence. This in turn gives rise to a review of evaluation methodologies used in the literature and related data issues. The section also considers evidence for reverse linkages: the impacts of the epidemic on sexual as well as reproductive behaviours.

Section 3 considers linkages with poverty, that is, the relations connecting to the left-hand side of Figure 10.1. First we discuss evidence from Africa on the pathways from poverty to HIV/AIDS, operating via reproductive health, reproductive/sexual behaviours and knowledge, and the use of services, as well as through other possible routes. We follow this with a discussion of the reverse pathway, that is, the effects of HIV/AIDS on poverty. Two distinct strands of literature are considered: that concerned with micro (individual or household level) poverty impacts, and that concerned with macroeconomic or growth impacts. Econometric studies of micro level impacts are now quite numerous and we have thus examined impacts on a wide range of outcomes, including household income and consumption, demographic structure, and children's health and schooling.

The emphasis throughout this chapter is, in one way or another, on reproductive and sexual *behaviours* as well as knowledge: how behaviours mediate the relationship between poverty and HIV/AIDS, what is known about how behaviour responds to the epidemic or to interventions designed to affect HIV risk or fertility, etc. These behaviours, of course, are what economists and demographers analyse. Consequently there is not a lot said here about medical or clinical research on HIV and fertility. Still, it will frequently be necessary to touch on these issues. One reason for this is that even purely medical interventions may lead to changes in behaviour that either enhances or compromise intended HIV prevention effects. It should also be noted that the research reviewed here as well as the discussion of research methodologies has a largely quantitative focus. This is hardly meant to imply that the techniques and findings of qualitative analyses by anthropologists or social psychologists for example, are not important in the study of poverty, reproductive health and HIV/AIDS. Instead it reflects, again, the research agendas and approaches of economists and demographers.

Linkages between Reproductive/Sexual Health, Behaviours and Policies on HIV/AIDS

Let us look again at the right-hand side of Figure 10.1 – the connections of reproductive and sexual health, services (including HIV interventions), and behaviours to each other and to HIV/AIDS. Reflecting the importance of

identifying effective prevention strategies, much of the discussion to follow focuses on what is known and not known about the effects of different HIV interventions, or more broadly reproductive health services, on risk behaviours and HIV incidence.

That is not to say that direct links from reproductive health per se (represented by the topmost circle in Figure 10.1) to HIV/AIDS are not important, they are, at least two such links have probably played a major role in the spread of the disease in Africa. They help to explain why so much of the continent has experienced generalised epidemics, with infections occurring in the overall adult population rather than concentrated within specific high risk groups such as sex workers and intravenous drug users as is the case elsewhere in the world.³

First, Africa has high rates of untreated non-HIV sexually transmitted infections (STIs) that are cofactors for HIV infection. STIs such as syphilis and herpes increase susceptibility to HIV via genital ulceration, which increases the likelihood of blood transmission during intercourse (Kapiga and Aitken, 2003). Further, such infections in HIV-positive men are associated with greater viral loads of HIV, which increases the likelihood of transmission to the partner (Cohen *et al.*, 1997). Oster (2005) develops an epidemiological model incorporating plausible sexual behaviour parameters for Africa and the United States that attempts to decompose the growth of HIV prevalence into behaviour and transmission rate determinants. Her simulations suggest that the vast differences in US and African prevalence rates are due primarily to differences in the transmission rates of the virus, which would largely be a reflection of the high levels of untreated STIs in Africa.

A second important cofactor for HIV is male circumcision or, more precisely, not having been circumcised. In East and Southern Africa, the regions in Africa with the highest prevalence, circumcision rates on average are significantly lower than in West Africa, where most men are circumcised and HIV rates are lowest. Non-circumcision may raise susceptibility to HIV infection directly⁴ as well as indirectly by increasing susceptibility to cofactor STIs. A review of observational studies for Africa indicates that male circumcision is associated with a significantly reduced risk of HIV infection among men, with an adjusted relative risk of 0.42. (Weiss *et al.* 2000). These comparisons cannot account for all cultural and behavioural differences that distinguish circumcised and uncircumcised male populations, but recent experimental evidence confirms that circumcision significantly reduces transmission risks.

Also, with respect to physiological factors, there is evidence that pregnancy increases women's susceptibility to infection. Prospective studies of women from Malawi (Taha *et al.*, 1998) and Rwanda (Leroy *et al.*, 1994) indicate higher incidence of HIV among women who are pregnant. These comparisons did not control for differences in risk behaviours or partner characteristics. However, a more recent study of Uganda, (Gray *et al.*, 2005) did control for risk behaviours of women and their male partners. The findings reveal a (temporary) doubling of the

risk of HIV acquisition during pregnancy. The increased risk may result from the fact that pregnancy leads to a temporary reduction in CD4 count,⁵ or from hormonal changes in pregnancy that lead to changes in genital tract conditions.

Links between Reproductive and Sexual Behaviours, and HIV/AIDS

A great deal has been written about the implications of the patterns of sexual behaviour for the spread of HIV/AIDS in Africa. The region is distinguished, as noted, by the high prevalence of untreated STDs and, in some areas, low rates of male circumcision, each a significant cofactor for HIV infection. But with respect to behaviour there are differences as well, in particular in terms of “sexual mixing” patterns. Surveys of self-reported sexual behaviour in different regions of the world indicate that Africans do not have more sexual partners over their lifetimes than people in other regions. What is different is that it is much more common in Africa than elsewhere to have two or more *concurrent* long-term partnerships. In the West and in Asia, in contrast, individuals are more likely to be serially monogamous, or else if they are not, concurrent partnerships are usually short term, e.g., involving a visit to a commercial sex worker.

With concurrent partnerships that are long term, many more people at a given point of time are linked in sex networks rather than in situations where serial monogamy is predominant (Morris and Kretzschmar, 1997; Halperin and Epstein, 2004). These networks allow the virus to spread rapidly in the population. The effects of concurrency are exacerbated by the fact that the HIV viral load, and thus infectivity, is much higher during the initial weeks or months after infection. With serial monogamy, the virus will be trapped in a single relationship until that period passes, whereas concurrency has the potential to expose many more people to the virus during the period.

The implications of concurrency for the growth of the epidemic can be demonstrated mathematically (see Morris and Kretzschmar). Empirically, one can learn about partnership behaviour from standard surveys of sexual behaviour in random samples of individuals, but it is very difficult to deduce the structure of sexual networks from this information. What is required is information on the behaviour of all people in a network and the tracing of the relationships among them. Gathering such comprehensive data is a difficult and resource-intensive proposition, and there appears to be only one example for Africa, the ongoing project in Malawi reported by Kohler and HELLERINGER (2006) which surveys all sexually active individuals of age 18–35 in seven villages in an isolated rural area. Reflecting on the concurrent nature of sexual partnerships, two-thirds of the approximately 1,000 surveyed individuals were connected to each other in a sex network via relationships occurring within the previous three years.

On the basis of the work of Morris and others, the tendency towards concurrent partnerships in Africa is widely viewed as an important factor behind the region’s uniquely severe AIDS epidemic. The question remaining is how important is this

behavioural phenomenon relative to the physiological factors of low male circumcision and high rates of untreated STIs. Most observers however would probably consider all of them to be important contributing factors (see Halperin and Epstein, 2004).⁶

Another aspect of sexual behaviours that has drawn a lot of attention is the prevalence in many African societies of sexual relationships between young women and significantly older men, whether through marriage or outside of it. Logically speaking, if all young people engaged in sex only with others in their age group from the time they became sexually active, the epidemic would not be able to continue beyond the current generation of older adults. Sexual mixing via relationships between young women and older men thus provides the virus with a route from older to younger generations. It is reflected in the substantial gender imbalance in infection rates among young people aged 15–24 years – an estimated 4.6 per cent for females and 1.7 per cent for males across the region (UNAIDS, 2006).

For fairly obvious reasons, fertility patterns and preferences can also encourage or inhibit the spread of HIV. Married women who, in an effort to limit their family size, reduce the frequency of unprotected intercourse via condoms or reduce the overall frequency of sex lower their risk of contracting HIV from infected partners. In high fertility societies where young women get married (usually to older men) and begin childbearing early, the risk of infection, all things being equal, is higher. At the same time, however, early marriage will mean less potentially risky premarital sex with non-steady partners, so the net effect on HIV risk is uncertain. Finally, the physiological link between pregnancy and HIV susceptibility noted in the last section suggests another way in which high fertility women are more vulnerable to the disease.

HIV Prevention Policies: Evidence and Gaps in Knowledge

The search for effective HIV prevention strategies undoubtedly forms the most crucial research agenda among the topics discussed in this chapter. Solutions to the crisis have proved elusive. Until relatively recently, when declines in HIV prevalence were recorded in countries such as Kenya, Zimbabwe and Zambia, only Uganda, among the African countries experiencing generalised epidemics, could claim to have significantly reduced HIV prevalence and incidence. The success in Uganda has been at least in part attributable to reductions in risk behaviours suggesting that the country's experiences should hold important lessons for other countries attempting to devise effective strategies for behaviour change. There is less than complete agreement on what those lessons are, however.

First, it should be noted that HIV prevention policy is by no means limited to interventions designed to alter behaviour. There are a number of potentially important interventions that are essentially medical in nature. As suggested earlier, several of these are of interest to behavioural scientists because they may

have significant secondary effects on the epidemic through induced changes in risk behaviours.

Medical interventions

Anti-retroviral drug therapy figures prominently among medical HIV interventions. There are two distinct applications of ARVs: to prevent mother to child transmission (MTCT) of HIV and to extend the lives of HIV-positive adults. The former has been the subject of clinical trials in Africa, which have indicated that even a single dose of the anti-retroviral drug nevirapine given to the mother at the onset of labour and to the baby after delivery reduces by about half the rate of HIV transmission (see Guay *et al.*, 1999; WHO, 2006). ARV therapy (ART) for adults, long available in the developed world, is expanding rapidly in Africa, although still reaching only a fraction of those who need it. Several studies confirm the life-extending benefits of the drugs in the context of very poor countries (Ferradini *et al.*, 2006; Severe *et al.*, 2005).

ART for adults is not a prevention intervention per se, but it nonetheless may have impacts on the spread of HIV, impacts that are mediated by behavioural responses. Patients receiving the drugs become much less infectious than before (the presence of the virus in their bloodstream drops precipitously), but if they had been very ill before treatment, they are also likely to become more sexually active – and of course, they will be alive and able to transmit the virus for a longer period of time. Perhaps more importantly, individuals who are not ill or knowingly HIV positive may experience treatment optimism: knowing that they can get treatment if they contract HIV encourages them to engage in more risky behaviours. This is an example of a negative externality, but there are also potential positive externalities, such as a reduction in AIDS stigma and a greater willingness of people to get tested if they know treatment is available (Moatti *et. al.*, 2002).⁷ Informal evidence (see Glick, 2005) indicates that the utilisation of testing services surges when clinics begin offering ARVs. Still, it is not clear whether demand for testing increases primarily among those who are already ill with AIDS (hence less likely to be sexually active and in danger of infecting others) or also among the apparently healthy, including HIV-positive but asymptomatic individuals who are still sexually active and therefore at risk of spreading the virus. From a prevention perspective this distinction is important. These and other behavioural impacts of ARV provision have yet to be considered rigorously. As discussed later in the chapter, to do so requires the collection of population-based data, and not just clinic-based data on individuals receiving treatment.

The foregoing discussion of cofactors for HIV infection points to two other medical interventions that (via the link from “services” to HIV shown in Figure 10.1) may have significant effects on the spread of the disease: STI control and male circumcision. The recently concluded randomised ANRS trial in South Africa (supported by the Agence Nationale de Recherches sur le SIDA of France), using HIV infection as the endpoint, confirms the benefits of male circumcision in terms

of reducing the risk of transmission: Incidence was about 60 per cent lower in the group of men getting the procedure relative to controls (Auvert *et al.*, 2005).

Although this trial suggests potentially very significant prevention benefits to male circumcision, there is concern that male circumcision will lead to adverse behavioural reaction through risk compensation (Cassell *et al.*, 2006). It is hard to convey the concept of partial protection, which is what circumcision provides, so men may feel free to engage in more risky behaviour than before. This can in theory result in a net increase in their infection risk. Indeed, in the ANRS study, most indicators of sexual risk behaviour were higher in the treatment group than the control group following the start of the trial. Despite this, however, the estimate of the protective effect of circumcision was not sensitive to adjustment for participants' self-reported sexual behaviours. On balance, therefore, this study suggests that the benefits to circumcision will be large enough to overwhelm the negative behavioural responses, so this intervention remains very promising. More research needs to be done, however, on the endogenous behavioural responses to circumcision.

With respect to the effects of comprehensive STI treatment programmes, findings from three rural community randomised trials, in Rakai and Masaka in Uganda, and Mwanza in Tanzania, are mixed in terms of HIV incidence outcomes, even though STI incidence fell in each case (Grosskurth *et al.*, 1995; Wawer *et al.*, 1999; Kamali *et al.*, 2003). Only in the Tanzania case was there also a reduction in new HIV infections. Together, these three studies suggest that STI control will yield HIV prevention benefits when (as in Tanzania) the epidemic is less mature, when transmission is still occurring primarily in specific high risk groups and before there has been significant behaviour change in the population (Korenromp *et al.*, 2005). Note that in this case, while there may not be significant effects of the intervention on risk behaviour, understanding the nature of that behaviour and of sex networks is necessary in order to interpret the findings.

Behavioural interventions

HIV prevention interventions that are explicitly designed to alter behaviour include voluntary counselling and testing (VCT); provision and social marketing of condoms; public information campaigns emphasising prevention behaviours, such as the "ABC" approach (Abstain, Be faithful, use Condoms); and a host of education programmes aimed at youth to provide HIV knowledge and encourage safe behaviours, most commonly delaying sexual debut. Note also that standard reproductive services will also potentially affect the rate of new infections via changes in behaviour. For example, if women use condoms from family planning clinics for the purpose of birth control they will also reduce their risk of exposure or transmission of the virus. Family planning services also generally provide HIV risk and prevention information to their clients, which can lead to changes in behaviour and the risk of infection.

Behaviour change promotion: A, B and C. Considering first behaviour change promotion, Uganda remains the standard bearer for behaviour change in high prevalence countries and its experience has inspired a great deal of discussion and debate. From the early 1990s to 2001, HIV prevalence in Uganda fell by two-thirds, from 15 per cent to around 5 per cent of the population. Much of this reduction is attributable to the natural course of the epidemic, via rising mortality as the initial group of HIV-infected persons began to succumb to AIDS; mortality also reduced incidence by removing infected individuals from sex networks. However, it is generally agreed that reductions in risk behaviours also played a significant role. (Singh *et al.*, 2003; Slutkin *et al.*, 2006; Stoneburner and Low-Beer, 2004). Demographic and Health Survey data indicated a 60 per cent decline in sex with non-regular partners between 1989 and 1995 as well as increases among young people in age at sexual debut (Stoneburner and Low-Beer), although there is some concern over the comparability of such surveys over time (Grey *et al.*, 2006).

One can consider Uganda's (and other countries') experience along two dimensions: the broad policy stance, meaning the overall nature and intensity of the efforts of government and other actors in getting prevention messages across, and the content of the messages themselves. Uganda clearly indicates the importance of the former dimension. Under the very visible leadership of President Yoweri Museveni, the government attempted to counter the epidemic earlier (starting in the mid 1980s) and far more aggressively than in other countries.⁸ This involved the use of mass media and the mobilisation of community and church leaders as well as non-government organisations (NGOs) in education campaigns. Many observers have noted that the frequent open public discussion about AIDS served to destigmatise the disease. This is a somewhat difficult concept to quantify empirically, but it is worth noting that by the mid 1990s the share of individuals indicating they knew someone with AIDS or who had died of AIDS was substantially higher in Uganda than in similarly (or worse) afflicted countries where general awareness of AIDS was equally high: 91.5 per cent of men and 86.4 per cent of women (in 1995), compared with 68 per cent to 71 per cent in Zambia, Kenya and Malawi and below 50 per cent in Zimbabwe. In South Africa, the share was below 50 per cent as late as 2002 (Stoneburner and Low-Beer, 2004). This suggests a widespread willingness to acknowledge the disease and presumably also the risks it poses.⁹

Exactly which behaviour change messages were successful – and which should be used now in Uganda and elsewhere – is still being debated. Uganda is said to be demonstrating the power of the “ABC” approach (Abstain, Be faithful, use Condoms) to prevention. As many observers have noted, however, condom promotion was not a major plank of Uganda's early national prevention strategy and condoms were not distributed or used widely enough to have played a significant role in the decline in HIV rates in the early 1990s (Green *et al.*, 2002). Nor did the early messages emphasise abstinence per se, although among the young, delayed sexual debut was encouraged (Slutkin *et al.*, 2006). The strongest

emphasis was on faithfulness to one's partner ("zero grazing" – having only one partner whose only partner is you), or if not that, minimising the number of casual partners.¹⁰ The evidence cited above indicates success in reducing the incidence of sex with non-regular partners as well as more modest reductions in sexual activity among youth.

Condoms began to be promoted more heavily in Uganda in the early to mid 1990s through social marketing campaigns. This new emphasis seems to have affected the nature of prevention. Longitudinal data from Rakai district for the period 1994–2003 indicate that falling HIV prevalence was due to a combination of (primarily) rising AIDS mortality, on the one hand, and behaviour change, on the other. This time, however, behaviour adjustment took the form of increased condom use; levels of other self-reported risk behaviours did not change or even increased over the period (Wawer *et al.*, 2005).

Therefore the Ugandan experience provides evidence for the efficacy of behaviour change messages emphasising partner reduction and, in a later period, condom use, although the latter success is clouded by the possibility that people who use condoms will feel free to increase or not reduce other risky behaviours. Abstinence apparently was promoted in the sense of messages to delay initiation of sexual activity, but not in the form of "abstinence only" (until marriage) education,¹¹ this may have led to some movement in age at sexual debut among young people. A general point that should be noted, however, when considering trends in behaviour, is that it is very hard to distinguish between the effects of policies (and even more so, specific policies) and the responses people are likely to make in the face of the epidemic even without these policies. That said the correspondence of aggressive mobilisation efforts and substantial behaviour change in Uganda from the late 1980s to the mid 1990s – and the comparative lack of both strong policies and behaviour adjustment in other countries at similar stages of the epidemic¹² – offers strong support for the idea that policy played a significant role in changing behaviour in Uganda.

With regard to condom promotion, few would argue with the efficacy of providing condoms to commercial sex workers and other typically very high-risk groups such as truck drivers and the military. Such drives, beginning with Thailand's 100 per cent condom use policy for brothels and subsequently copied elsewhere (UNAIDS, 2000; Larivee, 2002), have generally been quite successful both in achieving very high rates of condom use in the targeted populations and in bringing down infection rates in these populations. These successes, however, occurred in contexts of concentrated epidemics, where transmission was still occurring largely via these high-risk groups. In Africa, as noted, epidemics tend to be generalised, with transmission occurring throughout the general population. The issue then is whether condom promotion to the general population has been or can be an effective prevention strategy.

The African record on this to date is from one perspective rather disappointing. Countries such as Kenya, Botswana and South Africa had policies strongly promoting condoms for years with apparent success in increasing their acceptance and use but little to show in terms of reduced prevalence (Hearst and Chen, 2004). It is hard to draw conclusions from simple cross-country comparisons because countries differ in how aggressively the government in general pursued its AIDS education and prevention objectives.¹³ Still, these experiences indicate that it is unlikely that condom promotion in the absence of successful promotion of other risk behaviour reduction is sufficient to turn back the epidemic – there is no such condom success story (Green *et al.*, 2006). One problem is that users of condoms tend not to use them consistently (Hearst and Chen). Further, it is possible that even intermittent use of condoms provides a false sense of security so that people feel comfortable persisting in high-risk behaviours (Ahmed *et al.*, 2001); that is, they do not exhibit risk inhibition. A second problem is that people are reluctant to use condoms in long-term partnerships as this implies a lack of trust.¹⁴ Unfortunately, this is the context in which much or most HIV transmission occurs in Africa.

Nevertheless, in several countries (and in Rakai, Uganda, as noted previously) recent declines in HIV prevalence were associated with increasing condom use in casual partnerships. In these cases, unlike for Rakai, survey data reveals condom use increasing in step with reductions in other risk behaviours such as the number of partners and adolescent sexual activity. This pattern was demonstrated in Kenya (Cheluget *et al.*, 2006), Zimbabwe (UNAIDS, 2005; Gregson, Garnett, Nyamukapa, Hallett, Lewis, Mason *et al.*, 2006) and urban Zambia (Fylkesnes *et al.*, 2001). Condoms probably contributed to declines in new infections in these cases. It is also important to point out that access to and use of condoms is essential when (as in Uganda today) half or more of new infections occur in serodiscordant couples (couples in which one partner is infected but the other is not). For many of these couples abstinence is presumably unattractive (Merson *et al.*, 2000).

The evidence discussed above on condom promotion does not come from controlled studies or evaluations of specific programmes. For policies promoting condom use among the general public (as opposed to specific high-risk groups) such evaluations unfortunately are uncommon. Evidence of the effectiveness of condom promotion or social marketing programmes often relies on the numbers of condoms distributed or sold, and occasionally, changes in self-reported condom use. While condom promotion in Africa does appear to work in this sense (Hearst and Chen, 2004; Forheit, 2001; Myer *et al.*, 2001), the effect on prevention remains unclear without information on which groups (in terms of risk levels) use them, on whether they are used consistently, and on what happens with respect to other risk behaviours – and ultimately of course on changes in the rate of new infections.

A rare evaluation that does attempt to gather such data is a recent randomised trial in Kampala, Uganda (Kajubi *et al.*, 2005). Recruited men in one poor community participated in a workshop that taught condom skills and encouraged condom use. Men in the control community received a brief informational presentation about

AIDS. All participants received coupons redeemable for free condoms from distributors in both communities and completed questionnaires at baseline and six months later. It was found that men in the intervention group redeemed significantly more condom coupons than men in the control group, but they also increased their number of sex partners by 0.31 compared with a decrease of 0.17 partners in the control group. Thus the gains from increased condom use seem to have been offset by increases in the number of sex partners. This study provides evidence of a disinhibition or “risk compensation” effect of condom use: individuals adopted one form of protective behaviour and compensated by being less careful in other dimensions, possibly leading to an increase in net HIV risk (especially if condoms were not used consistently). As noted, the trends in behaviour in Rakai since 1993 are also consistent with this process. Therefore questions remain about the overall impacts of condom promotion in generalised epidemics. Studies are needed, in particular, on the impacts of programmes promoting condoms in conjunction with a strong emphasis on other risk behaviour reductions. Ideally, the measured endpoints would include change in HIV incidence as well as behaviours.

With the exception of evaluations of voluntary counselling and testing and in-school interventions for youth, there are few studies of this type in Africa that evaluate specific behaviour change promotion programmes, at least with respect to impacts on behavioural or biological endpoints. Williams *et al.* (2003) assessed the effects of an intensive HIV intervention started in 1998 in a mining community in South Africa. The programme included community-based peer education, condom distribution, syndromic management of sexually transmitted infections and presumptive STI treatment for sex workers. Despite the intervention there was little evidence of significant behaviour change over a two-year period and the prevalence of non-HIV STIs actually increased. It should be noted that there was no control community; the method was a simple pre- and post-test design using two cross-section surveys. The authors suggest that the context was important in explaining the lack of response to the intervention: AIDS mortality was still low, and the South African government was not putting out broader messages about HIV risk and behaviour change.

A rather different behaviour change intervention, similarly evaluated in a simple pre-test/post-test framework, was an AIDS prevention project implemented in Muslim communities in Uganda (Kagimu *et al.*, 1998). This intervention trained religious leaders who in turn educated their communities about AIDS. After two years, there was a significant increase in the share of residents with correct knowledge of HIV transmission, methods of preventing HIV infection, and the risks associated with ablution of the dead and unsterile circumcision. Reductions in sexual risk behaviours were also recorded. However, the study design did not allow the disentangling of intervention effects from trends in these communities or in the country as whole.

Differences between these programme evaluations and the type of data discussed above need clarifying. The latter consists essentially of trends observed in cohort or repeated cross-section data in a country or subnational region. As such, outcomes may reflect the influence of factors other than the policy of interest that have also changed over time, such as increasing knowledge of AIDS risk diffusing through social networks, endogenous responses to changes in prevalence and mortality, and the operation of other policies and actors, for example, NGOs. The lack of a control or comparison group makes it impossible to distinguish policy impacts from these confounding factors (this is also a problem, of course, in project evaluations that do not have control groups). The best one can usually do is to compare trends in countries where policy approaches have differed, or as in the case of Uganda, consider different periods between which policy shifted emphasis from one prevention approach to another. Of course, many other things may be different across countries or time periods.¹⁵

Programmes aimed at youth. In Africa as elsewhere, many programmes have sought to educate young people about the risks of HIV and reduce behaviours that expose them to risk such as early sexual initiation, sex without condoms or sex before marriage. Most commonly, these programmes operate through schools. The evidence of their efficacy in Africa is at best mixed. A recent comprehensive review of 11 school-based HIV education programmes (Gallant and Tyndale, 2004) indicates that while such interventions can be successful at improving young people's HIV awareness and attitudes, most did not produce sustained changes in behaviour.

Most of these evaluations did not employ randomised designs, and most used self-reported behaviour outcomes as endpoints rather than HIV infections or other biological markers such as teenage pregnancy or STIs. However, several additional school-based prevention programmes in Africa do make use of randomised controlled trials (RCTs) and in a few cases; the measured outcomes include HIV incidence or other biomarkers. These too have produced mixed results. In rural Tanzania, a community-randomised design was used to evaluate a project including in-school education, youth-friendly health services, and community-based condom promotion and distribution. The programme led to improved knowledge, attitudes and self-reported behaviours in the ten intervention communities relative to the controls, but there was no consistent impact on biological indicators of HIV, other STIs or pregnancy (DFID, 2004). A Rakai, Uganda, RCT of an extracurricular education programme (Kinsman *et al.*, 2001) found no significant impact on teenagers' self-reported behaviours; in this case poor implementation may be partly to blame.

A multi-pronged randomised evaluation in Western Kenya (Dreyfuss *et al.*, 2006) found that training teachers in Kenya for the HIV/AIDS curriculum did not lead to any reduction in teenage pregnancy but did increase the likelihood that teenage pregnancies occur within marriage. In-class debates over condoms and opportunities to write essays on ways of protecting oneself against HIV/AIDS led to

increased self-reported use of condoms without an increase in self-reported sexual activity. Reductions in the cost of schooling led to reductions in both dropout rates and teen pregnancies. As Duflo *et al.* note, in the absence of biomarker outcome measures, the implications of each of these programme effects for HIV risk, while promising, are not clear. For example, an increase in teenage pregnancy within marriage at the expense of pregnancy outside of it may actually increase HIV risk if there is a greater tendency for the former to involve unprotected sex with older men.

On that score, a promising recent finding (Dupas, 2006), from an extension of the same Kenya project, is that a programme informing girls about the much higher HIV risk from older men relative to teenage boys led to a 65 per cent decrease in the incidence of pregnancies by adult partners among teenage girls in the treatment group relative to the comparison group. Given these striking results, it would be of interest to replicate and evaluate this type of programme in other contexts. Further, the generally disappointing findings for many other interventions aimed at youth point to the need for more careful design and evaluation of such programmes. The need for rigorous evaluation would certainly apply to “abstinence-only” programmes, which are being heavily promoted in Uganda and elsewhere. There are no evaluations in Africa of this approach or comparisons of it with other programmes for youth, but abstinence-only programmes in the United States have by and large been found to be ineffective at delaying sexual initiation and reducing sexual risk-taking behaviours in the long term (Kirby, 2001).¹⁶

The foregoing review has been the concern of school-based awareness and prevention programmes. Evaluations of non-school interventions aimed at youth are less common, presumably a reflection in part of the much greater ease with which evaluators can survey young people in their schools.¹⁷ Agha (2002) reports on a quasi-experimental evaluation of adolescent sexual health interventions in four African countries (Cameroon, Botswana, South Africa and Guinea) in the mid to late 1990s. These interventions combined to varying degrees mass media (radio messages), sponsored events, peer education and youth-friendly contraceptive services. Changes between baseline and follow-up surveys were compared for intervention of towns or neighbourhoods and selected comparison locales. Population impacts on perceptions and self-reported behaviours varied (and tended to be larger for young women), but one conclusion drawn is that more intensive interventions using a variety of channels are needed to insure that a large share of adolescents is reached.

HIV testing. Currently only small minorities of adults in Africa are aware of their HIV status, but many governments hope to change this by expanding access to testing and counselling services. Voluntary HIV counselling and testing (VCT) typically consists of a pre-test counselling session with a trained counsellor, the serotest itself, and a post-test session in which individuals are counselled on behaviours to ensure that they remain uninfected (if they test negative) or avoid infecting others (if positive). Those testing positive are also provided emotional

support, and directed to services to provide palliative care and other forms of support. Testing is also the gateway to anti-retroviral drug therapies for HIV-positive individuals. This role of HIV testing is growing in importance as many African countries scale up the provision of ARV drugs.

Although there are a number of evaluations of VCT in Africa, most are based on simple single group pre-test and post-test designs, in which (self-selected) clients are interviewed before they receive the testing and counselling and are followed up some time later. (See Glick, 2005, for a review of this research.) Without similar baseline and follow-up information for a control or comparison group, it is not possible to distinguish the effects of the intervention from general trends in behaviour over time. Equally important is the problem of self-selection. Given the heterogeneity in the population with respect to (for example) the motivation for behaviour change and risk avoidance, those who choose to use VCT may be especially responsive to the information received about their serostatus and about HIV prevention. Hence they may adjust their behaviour following VCT more than would individuals in the target population in general.

For these reasons, the first randomised controlled trial of VCT in Africa, conducted in urban Kenya and Tanzania as well as Trinidad (Voluntary HIV-1 Counselling and Testing Efficacy Study Group, 2000), attracted significant attention in both the research community and the popular press. Volunteers interested in testing were randomly assigned to intervention and control groups; the latter were given general information about HIV/AIDS but not VCT.¹⁸ Relative to controls, there were reductions in unprotected sex among testing serodiscordant couples (the study design ensured adequate representation of couples testing together) and among HIV-positive testers in general. Changes in behaviour among those testing negative were much smaller. This is the same general pattern, in fact, that was found in many non-experimental studies. It suggests that the testing and counselling has some value in secondary prevention (i.e., preventing infection of the partners of those who are HIV positive), but less impact on preventing primary infection among those who are HIV negative.

The public health effectiveness of voluntary programmes such as VCT depends not just on the response of those who participate, but on the extent of participation, or programme coverage. For most countries in Africa, Demographic and Health Surveys (DHSs) indicate very low numbers reporting having had an HIV test but high shares (about two-thirds) saying they would like to learn their status (Glick and Sahn, 2007). In Kenya, where the government in recent years has been rapidly expanding the number of testing sites, the overall numbers tested annually have increased dramatically, from 1,100 in 2000 to over half a million in 2005 (Marum *et al.*, 2006), pointing to a strong demand for testing that had been constrained by the shortage of facilities. However, a formal analysis of the demand for HIV testing requires the use of population-based survey data collected in areas where the service is available.

The findings from several such studies provide a mixed picture. In the rural Rakai, Uganda, study (Nyblade *et al.*, 2000), VCT services were offered to all individuals, they had the option to receive the service in their homes or at a nearby clinic. Despite significant outreach, demand in the initial year of the programme (1995/96) was not very high – 32 per cent of women and 35 per cent of men agreed to receive their test results. However, this jumped to 65 per cent for both gender in 1999/2000 (Matovu *et al.*, 2002).¹⁹ In an urban Zambia study (Fylkesnes and Siziya, 2004), uptake was much lower. Even where there was similar flexibility in setting (a clinic or at home) the probability of a person both indicating “readiness” for testing and using the service was only about 18 per cent.

Similarly, in a more recent study of rural Malawi (Thornton, 2006) only about 40 per cent of the individuals offered free testing chose to attend clinics to learn their HIV status. On the other hand, demand was very sensitive to monetary incentives: small cash payments (offered on randomly assigned basis) were enough to double the use of the testing service. This study not only randomised the testing incentive; it also used an objectively measured rather than self-reported behavioural outcome, namely, whether the individual decides to purchase condoms at the subsidised price. Consistent with studies of VCT outcomes discussed above, testing had no effect on condom purchases for those testing negative, but those who tested positive and had a partner purchased significantly more condoms than non-testers. The average number of condoms purchased was small, however, so the overall cost-effectiveness of VCT in this setting was low.

The evident reluctance on the part of many to get tested may reflect a number of factors: significant stigma attached to AIDS, stress, and a strong reluctance to reveal a positive test result to a partner, particularly for women who may realistically fear domestic violence or divorce as a consequence. In view of these factors, some observers have recently questioned the usefulness of the VCT model for Africa (and elsewhere). Imported from developed countries, the VCT approach, as the word voluntary implies, typically places a premium on privacy and personal choice in health care. In contrast, a policy of mandatory – or perhaps more accurately routine²⁰ – testing would automatically test all individuals entering the health care system. Such a policy treats HIV as a public health issue in the same manner as other communicable diseases have been treated in the past in the West. Botswana and Lesotho have recently become the first African countries to initiate national policies of routine HIV testing.

Both the ethics and efficacy of mandatory testing have been hotly debated (see UNAIDS, 2004; and Holbrooke and Furman, 2004, for opposing views). The population level implications for risk behaviour and the coverage of testing itself are unknown; with regard to the latter, it is possible that certain high risk or vulnerable groups will respond to a policy of automatic testing by deciding to stay away from the health system entirely. Assuming that coverage does increase significantly under routine testing, it is quite possible that the average behavioural response to testing and counselling will be different from what was observed in the

samples studied in the VCT evaluation literature. This is because coverage will move beyond those who actively volunteer to be tested (presumably meaning those who perceive the greatest benefit from the information), to those who have less interest in knowing their status. Several plausible models of the demand for HIV testing and for behaviour change predict that those who perceive less benefit to testing (and who therefore are not among those who test early on) will adjust their behaviour less in response to the intervention, although the opposite pattern is also possible (see Glick, 2005).

This consideration applies as well to other policies designed to significantly expand coverage of testing or VCT, whether by offering cash incentives or by changing the mode of service delivery, e.g., replacing standard VCT clinics with mobile testing units. With respect to evaluation, it is obvious that to understand the demand (uptake) impacts as well as the behavioural effects of these policies, it will be necessary to analyse population-based data and not the clinical data used in most VCT studies. As noted earlier, this applies also to assessments of the behavioural impacts (including impacts on testing demand) of making ART available to HIV-positive individuals or those with AIDS.

Integration of HIV prevention and care into existing family planning/reproductive health services. This issue is especially pertinent to a discussion that is concerned with the intersection of HIV/AIDS, reproductive health and fertility. By and large throughout Africa, the current approach implements services for HIV (and STI) prevention, testing and care separately from traditional family planning and reproductive health care, with the exception of interventions to reduce mother to child HIV transmission. Many, including UNAIDS and the United Nations Population Fund (UNFPA 2004a/b), make an efficiency argument for integrating the two. Existing reproductive health infrastructures provide a ready-made conduit to supply HIV-related services, and combining the provision of both kinds of services would enable the realisation of economies of scale in delivery. It would also ensure that women in particular get access to HIV services.

Others are sceptical about integration in the African context, however (see Caldwell and Caldwell, 2002; Forheit *et al.*, 2002). The primary concern is that traditional family planning and maternal/infant health services, on the one hand, and HIV services, on the other, generally serve different clientele with different needs. The main clientele for family planning and related services is married women. For many HIV services (testing, condom provision, etc.) the clientele will consist of men, or of adolescents of both gender. Concentrating HIV resources in family planning settings may alienate these groups, making them embarrassed or reluctant to use the services and possibly harming prevention efforts overall. Adolescents, for example, might be better served via separate youth-friendly programmes. It has also been pointed out that since (as inequitable as this situation may be) women often lack power in sexual decision making, behaviour change efforts targeted at the main clientele of family planning/reproductive health services may be ineffective.

The feasibility and benefits of providing a range of HIV/STI services to the typical female clientele of family planning/reproductive health centres (as opposed to trying to reach other key groups via these means) is a somewhat different matter. Askew and Maggwa (2002) note that even for this more limited objective there may be difficulties, citing unfavourable experiences in Africa with the detection and treatment of (non-HIV) STIs in family planning clinics. On the other hand, integration may be more feasible for certain activities, such as prevention of mother to child transmission and VCT. Ongoing research in Ethiopia and South Africa (Perchal *et al.*, 2006; Homan *et al.*, 2006) suggests that this can be cost-effective.²¹ Integrating services such as VCT into family planning/reproductive health centres may also increase testing among women (if not men) by providing a more secure environment for them than stand-alone VCT centres.

It has also been pointed out (Reynolds, 2006; Mphuru *et al.*, 2006) that many potential clients of VCT – in particular adolescent girls – are also at risk of unintended pregnancy. Such pregnancies might be reduced if family planning information and contraceptives were offered in conjunction with HIV testing. In other words, family planning coverage and impacts may be strengthened by integration with HIV prevention programmes. The notion that one can protect oneself against both HIV/STIs and unwanted pregnancy (“dual protection”) may increase the attractiveness of condoms and other risk prevention methods (WHO, 2003), especially for the young and unmarried. Indeed, a recent analysis of trends in DHS data from 18 African countries (Cleland and Ali, 2006) documents a substantial rise in the use of condoms reported by young, sexually active single women, and at least 60 per cent of those using a condom at last instance of sex said they did so mainly or partly to prevent pregnancy. These findings suggest that among this group, promotion of condoms as a contraceptive device may be more effective than emphasising the HIV/STI protection benefits. This is a further argument for the integration of family planning and HIV/STI prevention for this population – but not necessarily through existing family planning networks, which are not used by young single women.

At this time, the overall effectiveness (and cost-effectiveness) of service integration with respect to HIV prevention objectives, and in particular, the impacts on the use of HIV-related services by non-traditional clientele such as men and adolescents, is not known. This would require more complex study designs than have been used so far to study the issue. For example, population-based surveys would be needed in both intervention and control communities to understand the impacts on uptake of both fertility/reproductive health services and HIV/STI services among different at-risk groups in the population.

Methodological Issues in the Evaluation of HIV and Reproductive Health Interventions

There are many studies in Africa evaluating the effects of various interventions on behaviour and (more rarely) HIV incidence or other biological endpoints such as

STI infection and pregnancy, the preceding discussion made this clear, however, many questions remain as to which programmes are truly effective. Conflicting or inconclusive results in the evaluation literature may reflect differences in study contexts as well as variation in the quality of programmes or their implementation. But another factor that is probably also very important is variation in study design and evaluation methodology. There are many methodological challenges to evaluating behavioural HIV interventions and most existing evaluations do not meet these challenges completely.

The most serious challenge arises from the fact that, as alluded to above, people usually choose whether or not to participate in an intervention or use a service. Those who do so may not be representative of the overall population or the target population for the intervention. We might expect participants to be relatively responsive to the information or behaviour change messages received. On the other hand, if participants in a prevention-related programme do have a greater propensity to adjust their behaviour, they may have made these adjustments prior to participating. In the first case, comparison of participants and non-participants will overstate the likely benefits of the programme for the target population as a whole, while in the second case it will understate them.

Community-level assessments of programme impacts, in which mean outcomes at the community level are measured, may suffer from a similar problem, because the placement of programmes is usually not random. Placement may be related to a range of local characteristics, such as the demand for services or a greater perceived need for them in the eyes of policy makers (e.g., because of very high rates of risky behaviours or HIV prevalence in the community). These characteristics may easily be correlated with the outcomes to be influenced by the programme, and thus will bias assessments based on simple comparisons with communities not receiving the intervention.

In the following section we discuss alternative approaches to dealing with these issues when assessing the effects of HIV and related reproductive health interventions. First, however, mention should be made of the types of outcomes measured in the evaluations of programmes and policies, the variation in which was brought out by the preceding review of evidence. Typically, for behaviour change interventions the endpoints measured are self-reported risk behaviour correlates of HIV rather than HIV infections itself, although sometimes more objectively measured biological correlates such as STI infection or symptoms and pregnancy are used. There are good reasons for this. It is obviously of interest to understand the effects on behaviour, especially for interventions explicitly designed to affect behaviour. Further, attempting to directly measure impacts on the rate of new infections can mean significantly expanding the scope and complexity of the evaluation, both in terms of sample size (large samples may be needed to detect statistically significant changes in incidence, especially where incidence is low) and procedures (the study must be able to test participants for HIV at different points in

time, and ethical considerations dictate providing the existing standard of care to those testing positive).

One shortcoming of relying on behaviour data, however, is that the link between changes in specific behaviours and the potential for reductions in HIV incidence – the ultimate goal of prevention interventions – is not very clear. It depends on a host of factors, including who (in terms of risk status) is changing behaviour, the interactions of different behaviours that may be changing and the stage of the epidemic (Garnett *et al.*, 2006). There is, further, the well-known problem of biases in self-reported sexual behaviour information. Although surveys like the DHS manage to achieve very high response rates, people may not be willing to answer personal questions about their behaviour in a truthful way. In particular, comparisons of male and female responses suggest that women are prone to understate the number of partners they have; it is also possible that men, especially single men, overstate the number (see Gersovitz *et al.*, 1998).²² Data issues will be discussed further in subsequent sections.

Experimental designs. Given the problems of selectivity in programme participation and placement, the optimal approach to evaluation is usually to conduct randomised controlled trials (RCTs), or policy experiments, in which an intervention is randomly assigned to some individuals (or areas or schools, etc) and not to others. Generally in practice both groups are measured at baseline (pre-test) and follow-up (post-test), although this is not strictly necessary if the randomisation is done well, meaning that it results in essentially equivalent treatment and control groups.²³ The use of RCTs has been slow to gain ground in African HIV prevention research, and the number of examples remains fairly small, but the approach is becoming more common, we provide examples in the section following and then discuss alternative approaches to measuring the effects of policies.

Individual level randomisation, the standard design in medical trials, has so far been used in only a small number of HIV prevention behaviour evaluations in Africa. One prominent application of individual randomised controlled trials is the study of VCT conducted in urban Kenya and Tanzania (as well as Trinidad) mentioned earlier. Two other examples, also involving testing, are the studies reported by Thornton (2006) and Fylkesnes and Siziya (2004). In the former study, individuals in a rural Malawi sample were randomly assigned to receive cash incentives to get tested. As noted, demand for testing proved responsive to the monetary incentive. In Fylkesnes and Siziya's urban Zambia study, participants who had indicated readiness to be tested were randomly assigned to receive VCT at a clinic or in a setting chosen by the participant that included home counselling as one option. The mode of delivery mattered greatly: far more of those offered the choice of location used the service.

A different example is the RCT of male circumcision, in the recent ANRS trial in South Africa described earlier. In this study, participants who were men, initially expressed a willingness to be circumcised in order to reduce their HIV risk. This

group was then randomised into treatment and control groups (the latter were offered the procedure at the end of the trial). As noted earlier, there was a two-thirds reduction in HIV infection risk in the group of men getting circumcised.

In addition, several *community* (or more generally, *group*) level RCTs have been implemented in African settings. These have a number of important advantages for prevention research. Outcomes measured at the level of the community – whether they are biological endpoints or self-reported behaviours – capture the effects of local interactions and externalities that arise through social and sexual networks, learning, etc. The analysis at this level is intention to treat, since means of outcomes are measured over both participants and non-participants in the programme, usually using random samples of the catchment area population. Hence population level estimates of programme effectiveness are provided that reflect in part the uptake of the intervention. Examples of this approach include the three community-randomised trials of STI control, in Masaka and Rakai regions of Uganda, and in Mwanza, Tanzania. Another community-randomised trial currently under way in Tanzania, Zimbabwe and South Africa will compare population level incidence and behavioural outcomes of community-based HIV voluntary counselling and testing to standard clinic-based VCT. Other examples of group randomisation include the evaluations of school-based prevention education programmes discussed earlier in Uganda, Kenya and Tanzania. Here the randomisation is fairly straightforward: The intervention is introduced in some schools and not others.

Community randomised experiments would be the ideal approach for investigating a number of other HIV programmes that are hypothesised to generate significant external effects.²⁴ This would include the provision of anti-retrovirals. As discussed earlier, the prevention effects of this intervention, operating through the demand for testing and risk behaviours in the community at large, are potentially significant but little is known about them. The introduction of testing sites providing the drugs is typically staggered, reflecting resource and logistical constraints: the drugs will initially be available in certain areas and not others. The latter can form natural late treatment controls during the period for which ARVs are still unavailable in them. The implications of a policy of routine HIV testing could also be assessed using this approach, for example by implementing the policy in certain health districts and not others.

Randomised evaluations of fertility and reproductive health interventions that consider behavioural outcomes such as childbearing and contraceptive use are also rare in Africa.²⁵ This is true as well for quasi-experimental designs that approximate the setup of randomised controlled trials. Those that have been carried out have focused on demographic or health outcomes and have not explicitly considered possible HIV-related effects. One quasi-experimental evaluation for Africa is the Navrongo experiment in Ghana, a community-level analysis that considered the effects on fertility and child health of interventions for training community health officers and for community mobilisation (Phillips *et al.*, 2005). Another community trial (again, not randomised) in rural Gambia (Luck *et al.*, 2000) considered the

effects on modern contraception of the use of a community-based mobilisation intervention to increase the demand for contraceptives. A rare randomised community trial is the evaluation of the effects of community-based family planning outreach in Uganda (Lutalo *et al.*, 2006) on modern contraceptive use and pregnancy.

Quasi-experimental designs. Implementation of randomised experiments is often difficult for financial, logistical or political reasons. Randomised studies can be complex and are potentially costly, especially community-randomised trials. It is often difficult to get governments or donors to agree to distribute a service or drugs on a strictly randomised basis to certain communities (or schools or individuals) and not others. These factors in large part explain why randomised trials, outside of clinical settings for medical interventions, remain fairly rare in Africa.

There are certain methodological concerns as well. While the results of randomised trials may have internal validity in the sense of accurately measuring the effects of the intervention on those in the study, external validity – the applicability of the results to the full population or target population for the policy – may not be assured. This is especially a concern for smaller pilot studies. The study population in such cases will be relatively small and homogeneous, hence may not be representative of the target population overall. Another concern is that once a project is scaled up, the nature of the implementation of the intervention may differ significantly from the initial experimental study. For example, a small pilot project may be allocated more resources, have better supervision, and generate greater motivation on the part of service providers and beneficiaries than the same programme would if expanded to a national scale. To some extent, experiments can be designed to minimise these problems, in particular by carrying out the trials on a larger scale and using more representative study populations. However, this will raise the cost and complexity of the study.

For these reasons, a quasi-experimental design may be necessary or preferred. These are research designs in which the selection of treatment and comparison groups occurs by means other than random assignment, although the term is often used to refer to a range of statistical methods that attempt to establish causal effects of interventions that are not randomly assigned. Careful selection of comparison groups so that they are similar to treatment groups and the collection of baseline data (to control for remaining initial differences in the two groups) are essential. The two non-randomised community-level fertility interventions noted above adhere carefully to this approach, as does the study by Agha (2002) on adolescent sexual health interventions reported earlier. But many non-experimental evaluations, including evaluations of HIV interventions, do not. For example, a common design for VCT evaluations is simple pre-test/post-test in which there is no comparison or control group; instead the treated (VCT clients) act as their own control group via their pre-test or baseline data, and the effect of the intervention is measured by the change over time in their behaviour (see Glick, 2005). As

discussed, this approach fails to control for trends and shocks that may affect the outcomes independent of the intervention.

The option of using well-conceived quasi-experimental designs clearly opens up many more possibilities for meaningful policy evaluation. This is perhaps easiest to see for community-level evaluations. As noted for ARV provision, most programmes are not rolled out all at once. Even if the selection of communities that first receive the programmes is not random, it may be possible to select appropriate comparison communities among those not first in line to get the programmes for baseline and follow-up surveys.

Instrumental variable regression is another quasi-experimental approach and is one that is very familiar to economists. It is particularly useful for modelling individual level outcomes of programmes. Exogenous factors, including proximity to a service or programme, can be used to predict individual participation and thus the effects of the programme. Also familiar to economists are regression discontinuity designs and propensity score matching techniques. In the latter, individuals with observed characteristics similar to those of individuals receiving treatment are used as controls. This approach would appear to have limits when it comes to looking at interventions to change sexual behaviours (say, VCT), since participants are likely to differ from non-participants with respect not just to observed characteristics but also to unobserved propensities, attitudes or risk behaviours that affect HIV-related outcomes. The propensity score matching approach may be valid, however, for considering the effects of HIV/AIDS on outcomes of interest that are relatively far removed from sexual behaviours and attitudes. An example is Donovan *et al.*'s (2003) analysis of the effect of AIDS-related adult deaths on Rwandan agricultural households' cropping strategies and incomes.

Finally, in some cases researchers can take advantage of natural experiments, whereby there is a change in the policy or natural environment that can be regarded as random or exogenous with respect to the outcome of interest. Major changes in legislation may sometimes qualify as exogenous to behaviour, so that a causal effect of the new policy can be inferred. In demography a particularly strong example is given by the legislation passed by the government of the Romanian dictator Ceausescu in 1966 making family planning and abortion illegal (see Pop-Eleches, 2006); the policy was clearly imposed from the top and led to sudden and large increases in fertility. A natural experiment that has been exploited by researchers to estimate the effects of fertility on child health and other outcomes is the occurrence of the birth of twins, an (largely) exogenous event that yields an unanticipated increase in parity (Rosenzweig and Wolpin, 2000).

In HIV research there do not appear to be examples of the exploitation of natural policy experiments, but the approach may yet find applications. For example, the implementation of a policy of routine or mandatory HIV testing for all individuals entering the health care system will lead to increases in testing that may reasonably be considered as exogenous to individual risk behaviour, permitting the analysis of

the effects of knowledge of serostatus that is uncontaminated by unobserved differences in preferences or behaviour. (Note, however, that exogeneity will not be assured if many people exercise their option of refusing the test). With respect to natural experiments, one source of (plausibly exogenous) variation in exposure to HIV risk is in the distance to the epicentre of the AIDS epidemic in central Africa (Oster, 2006), since the accident of location of individuals (or societies) should not be directly related to levels of risk behaviour. As discussed further below, this makes distance a good instrumental variable for local HIV prevalence, incidence or mortality.

The foregoing review of methodologies and studies for the most part involves evaluations of specific, fairly narrowly focused HIV interventions. Understanding the reasons for success or failure in HIV prevention will inevitably also involve different kinds of assessments, especially when one is trying to understand the overall success or failure of a country's HIV/AIDS strategy. For example, while one may (and many have) debate which behaviour change messages were most effective in Uganda in the early 1990s, the country clearly differed from its neighbours in several broader aspects of policy: the very visible involvement of President Museveni, an aggressive media campaign, and the effective mobilisation of community leaders and churches in efforts to destigmatise the disease and promote safer behaviours. It is hardly feasible to set up experiments with all of these elements;²⁶ instead, comparative country analysis is called for, with a careful eye for nuances of policy and country idiosyncrasies.

A thoughtful example of this type of analysis is the comparative study of Uganda and Botswana by Allen and Heald (2004). They note that the leadership of Botswana, like that of Uganda, responded to the emerging epidemic with significant levels of resources and public commitment. But the effort in Botswana was singularly unsuccessful in bringing down prevalence. Allen and Heald argue that this is because of two related factors: the inability or unwillingness of the central leadership to fully engage local and church leaders, and the strong emphasis of the prevention policy on condoms, which contributed to the alienation of these traditional leaders from the mobilisation.

A second example is the analysis of Moore and Hogg (2004) on trends in HIV prevalence in 1990–2000 in areas in Western Kenya and Eastern Uganda near the border separating the two countries. Sentinel surveillance sites in the Uganda study area showed declines in prevalence, while no such changes were measured in Kenya. The two areas are geographically proximal and there are no obvious differences in terms of factors such as ethnic groupings or male circumcision rates. The authors thus conclude that the difference is due to Uganda's aggressive prevention policies contrasted with the relative inaction of the government in Kenya during the same period.

Effects of HIV/AIDS on Behaviour

Rising HIV prevalence is likely to feed back into behaviour.²⁷ When people see relatives and friends dying of a disease, it is expected that they will adjust their behaviour provided they are aware of how the disease is linked to that behaviour. Yet for most of Africa this response has been tragically slow (Caldwell, 2000). The following subsection considers the evidence for risk behaviour change and the effects of these changes in turn on the epidemic. In addition, the subsection discusses the related issue of the possible impacts of the epidemic on fertility in Africa.

Changes in risk behaviour

It is important to point out that it is very difficult to distinguish the effects of endogenous responses of the population to evidence of the disease, on the one hand, and responses induced by policies such as education campaigns, on the other. In principle this can be done in cross-country analysis in which a range of local HIV measures (prevalence, incidence or mortality) as well as prevention policy variables are included in regressions for behavioural outcomes. The policy variables would need to be appropriately standardised, which would be a challenging task. Less formally, as noted above, some research has compared the experiences of countries at similar stages of the epidemic but with well defined differences in policies.

A second obvious methodological problem is that, as the term feedback implies, there is correlation in the behaviour–prevalence relationship. Estimation of the effects of behaviour on HIV prevalence (or of incidence or mortality) will be biased because these variables are themselves functions of that behaviour. Several authors have attempted to apply instrumental variable techniques to deal with correlation. Instruments to predict HIV prevalence or incidence in these studies include male circumcision rates, prevalence of cofactor STIs and distance to the epicentre of the epidemic in central Africa (Breirova, 2002; Werker *et al.*, 2006; Oster, 2006; Kalemi Ozcan, 2006). Of these candidates, only distance seems to have a strong claim to be a valid instrument for HIV. Both circumcision rates and STI prevalence, in contrast, are likely to correlate with country or cultural characteristics that are also related to the outcome behaviours.

One might also use lagged HIV prevalence as an instrument for current prevalence. If the lagged measure was collected in the first years of the epidemic, before any behavioural responses are likely to have occurred, reverse causality from behaviour is not a problem (Kalemi-Ozcan, 2006). On the other hand, there is still a potential problem with heterogeneity in terms of country-specific time-invariant factors that are correlated both with lagged HIV prevalence and measured current behaviours. This means that lagged HIV prevalence fails the exclusion requirement for instrumental variables, as it would be correlated with current behaviours in other ways other than simply through its effect on current prevalence. Country-level fixed effects analysis – examination of within-country trends in HIV and behaviour – has

the opposite problem. It eliminates the effects of time-invariant country-level characteristics but is vulnerable to correlation bias through changes in behaviour affecting the trend in HIV.

Oster (2006) uses distance to predict HIV prevalence in a cross-country regression analysis of risk behaviour. She matches prevalence to self-reported behavioural data from DHSs for nine African countries. Estimated behavioural responses are very small. A 1 percentage point increase in the HIV prevalence rate decreases the share of women with multiple partners by 0.4 percentage points. For men, there seems to be no response at all to this behaviour.²⁸ Oster argues that these results can be explained by the traditional high (non-AIDS related) mortality in Africa. Given the likelihood of dying early anyway from other causes, the cost of risky sex is relatively small: There is (relatively) little expected lifetime consumption and utility to lose. Consistent with this hypothesis, the response to HIV is larger among individuals with higher incomes, which is associated with greater life expectancy.²⁹ A key and perhaps surprising implication of this analysis is that a simple economic model of behaviour appears to explain the variation in risk behaviour both within Africa and between Africans and a very different group, gay men in the United States. Observed differences between the two groups (that is, the much larger behaviour adjustment among gay men in the face of AIDS) largely reflect differences in income and the price of risky sex as just defined.

In contrast to these pessimistic cross-country findings for Africa, in at least a few African countries there is evidence that significant behaviour change has taken place. As always, Uganda stands out. As noted earlier, comparison of 1995 and 1989 Ugandan Demographic and Health Surveys point to large changes after 1989, especially a decrease in casual or non-regular partners. This period corresponds to the timing of the country's major decline in prevalence and more relevantly, incidence (inferred from trends in infection among younger cohorts).

Uganda is no longer the sole exception. Also as noted earlier, behaviour change has recently been documented in several other countries as well, and again, these changes correspond to declines in HIV prevalence or incidence. In Zimbabwe, where a general population cohort was followed from 1998 to 2003 in Manicaland Province, prevalence declined slightly, mirroring antenatal site trends for the country overall showing declines in 2000–2004 (UNAIDS, 2005). Sexually experienced men and women reported reductions in casual sex of 49 per cent and 22 per cent, respectively, over this period and younger cohorts reported delayed sexual debut. Data from multiple rounds of DHSs present a similar picture of behaviour change for Zimbabwe overall, with a substantial increase in condom use with non-regular partners and an increase in fidelity. Zambia DHS data present a more mixed picture, revealing declines in several risk behaviours to 1996, especially strong in the capital, but less movement afterwards. The changes in behaviour are thought to explain declining incidence in the 1990s in Zambia (Fylkesnes *et al.*, 2001). In Kenya, antenatal sentinel surveillance data indicate a decline in national HIV prevalence from 10 per cent in the late 1990s to 7 per cent

in 2004. DHS data from the same period indicates increases in age at first sex and condom use and a falling share of adults with multiple partners (Chelgut *et al.*, 2006).

Whether these changes in (self-reported) risk behaviours are sufficiently large to have contributed to the observed declines in HIV prevalence is not immediately clear. Answering this question requires epidemiological modelling. One approach is to simulate the natural course of the epidemic, and see how closely the observed pattern in prevalence over time corresponds to the model predictions. Where there is a divergence such that prevalence is falling faster than predicted, it can be inferred that behavioural changes have also been at work, altering the natural course of the epidemic. Hallet *et al.* (2006) apply this approach to several African countries (see also UNAIDS, 2005). Significantly, the simulations indicate that behaviour change in Uganda, Zimbabwe and urban Kenya contributed to reduction in HIV prevalence beyond that caused by the natural dynamics of the disease – that is, beyond the changes in mortality and incidence that occur as the disease progresses. In each of these countries, significant behaviour change was in fact observed. Elsewhere (Côte d'Ivoire, Malawi, Rwanda and Ethiopia), the model explains patterns in prevalence without behaviour change.

To return to the heading of this subsection, is it possible to say to what extent these behaviour changes reflect endogenous responses to the epidemic, as opposed to the impacts of public awareness campaigns and other policies? To be sure, each of the countries just discussed experienced full-scale epidemics, with high levels of premature adult mortality providing populations with powerful evidence of HIV risks. This has been argued by many to have been a major factor behind changes in behaviour (UNAIDS, 2005; Caldwell, 2000). However, the less favourable experiences of very high prevalence countries such as South Africa, Swaziland and Mozambique make it clear that endogenous behavioural responses to AIDS mortality are not the whole story: policy and possibly also cultural differences are important. But policy also varies considerably within the group of countries that have experienced changes in behaviour and prevalence/incidence. In Uganda (especially) and Zambia, the national government was aggressive in education efforts against HIV/AIDS (Bessinger *et al.*, 2003); in contrast to Zimbabwe and Kenya where the government joined the struggle on a large scale relatively late (where initial emphasis had been on condom promotion; see Chelugut *et al.*, 2006). Thus, the precise role of policy in explaining recent changes in behaviour (hence also in prevalence declines) is not clear.³⁰

Since these cases of significant risk behaviour change still appear to be the exception in Africa, they do not necessarily contradict Oster's cross-country findings of little overall behaviour response to variation in HIV prevalence. However, they are not outliers in the sense of being cases that are very atypical, hence uninteresting. Quite the contrary is true, as evidenced for example by the enormous efforts made to learn lessons from Uganda's recent history that might be applicable to other countries.

Can the changes in behaviour observed in Uganda be explained by an economic model of risk behaviour such as presented by Oster and others? As described above, risk behaviour in this framework is a function of individual optimisation subject to HIV risk knowledge, income and the price of unprotected sex, this last an increasing function of perceived transmission risk and income (the latter because greater future consumption and utility are lost for a wealthy person who contracts HIV and dies prematurely). We might surmise that behaviour adjustment in Uganda was substantially greater than such a model would predict, given the low levels of income and education prevailing in that country in the early 1990s. Understanding of HIV risk also was probably not very much greater in Uganda then than in other countries where behaviour changed far less in response to AIDS epidemics of comparable seriousness, as noted above. This suggests a strong role for public policy in Uganda's transition, as has already been argued. But it also brings out the notion that the role of policy is not just to provide information so that people accurately understand HIV risk – given low average incomes, awareness might not raise the cost of risky sex enough to significantly change behaviour³¹ – but to cause people to change their behaviour more than they otherwise would given risk knowledge, incomes and preferences.

One way this may have worked in Uganda and other settings is for government information campaigns to have been so successful in warning about HIV risk that they led people to *overestimate* the true risk, hence to adjust behaviour more than they would have if they had an accurate understanding of the risk. When a disease is characterised by massive negative externalities, as is the case for AIDS, this is by no means a bad outcome for public policy. There is evidence from developed countries that aggressive information campaigns do lead people to overestimate their individual risks of contracting certain diseases: A case in point is smoking and lung cancer in the United States (Cutler, 2002).

Another possibility is that Uganda's policy of openly and aggressively discussing AIDS in multiple forums not only made individuals more aware of risk, but changed social norms regarding acceptable personal behaviour. If changing social norms are internalised by individuals, preferences themselves have been changed (although one might rather say instead that the new norms raise the cost of certain behaviour because individuals are afraid of incurring the social opprobrium of the community). If this is the case, reducing levels of HIV risk behaviour involves a transformation more profound than merely altering the prices people face or providing them with information.³²

Most of the analyses of trends in risk behaviour discussed above rely on multiple rounds of nationally representative surveys such as the Demographic and Health Surveys with questions on behaviours such as age at first intercourse, use of condoms at last sex instance and number of partners in the past year. Researchers have also examined trends in antenatal site data on self-reported behaviours of clients and, occasionally, longitudinal data covering smaller populations. In principle, the analysis of repeated large, nationally representative surveys such as

the DHS is the most appropriate approach to understanding behaviour change in the population at large. However, it is important to be aware of potential pitfalls when using such data.³³ There are three primary sources of problems: changes in samples; changes in the questions posed; and changes in how people respond to these questions, or, changes in reporting errors.

The first problem occurs when the samples drawn in two surveys differ in ways that are related to behaviours. For example, mean levels of education and wealth may differ beyond what would be due to simple sampling errors. This is not supposed to occur in nationally representative samples – it obviously means that one or both samples are not representative – but can happen if, for example, the sampling frame for the survey changes, say because the national census has been updated and used for the later survey.³⁴ When the samples are different, differences in mean outcomes between earlier and later surveys may be spurious. With regard to changes in question posed, responses to questions about sexual behaviours may be sensitive to how they are asked, where in the survey they appear and how they are ordered. Finally, as people become more exposed to messages about HIV risk they are increasingly likely to believe that high-risk behaviours are viewed negatively by others. This may make them less inclined to tell interviewers about such behaviour; that is, there may be an increase in social desirability bias from one survey round to the next. This will lead to a spurious trend in the data toward apparently lower levels of risky behaviour.

Of these problems, changes sample is the easiest to detect and correct. It is straightforward to determine from the data if sample composition has changed, by comparing the sample means of individual or household characteristics in the two data sets. One should pay particular attention to characteristics that should not be changing over time, such as the mean years of education of adults in a given cohort (i.e., born in the same year or several-year interval): if the sampled populations are the same in two surveys, these means should be statistically the same (see Glick and Sahn, 2008). To adjust for changes in the sample, one can stratify the data on characteristics such as education and location and examine changes in behaviour within these categories, as in Zaba *et al.* (2004). A more flexible approach would be to estimate a regression (or probit, or other model as appropriate) for the behaviour including as regressors indicators for survey round and controls for a range of characteristics (education, age, location, wealth, etc.). Provided that this is the only data problem and that the included covariates are adequate to account for the relevant differences in the samples, the coefficient on survey year captures the change in behaviour between surveys controlling for between-sample differences in other factors that affect behaviour.³⁵

Changes in reporting error are more problematic: How can one determine if changes in self-reported behaviour represent true changes or merely a shift in how people answer questions about HIV-related behaviour? Assuming for the moment that the two samples are in fact representative then the first problem is not an issue, one could examine responses to the one standard question about HIV risk-related

behaviour that should always be the same across surveys for people in a given birth cohort: the age at which they first had sex, or alternately, if they had sex before marriage. That is to say, as long as the two samples are representative, mean age at first sex as reported by individuals age (say) 25–34 in a given year should be the same statistically as that reported in a survey conducted five years later by individuals age 30–39 (the age of the cohort five years on). Inconsistencies in within-cohort responses signal a problem in the data; in particular, if mean age at first sex for the same cohort is higher in later surveys, this may be a sign that social desirability bias is increasing – people are becoming less willing to admit to having engaged in high risk behaviours, even those occurring in the past.³⁶ If this is affecting responses to age at first sex questions, it plausibly biases responses about other risk behaviours as well, in the same direction. Note that changes in sample composition could also lead to differences in within-cohort responses between surveys, so where there is evidence of this, the within-cohort comparisons should stratify on key characteristics or use a regression framework with controls for these and other factors.³⁷

Several authors have examined the within-cohort consistency of age at first sex responses on repeated DHSs from Africa (Gersovitz, 2005; Glick and Sahn, 2008; Zaba *et al.*, 2004). Each of these authors reports at least some inconsistencies in responses. For example, Gersovitz (2005), considering these surveys from the mid 1990s to early 2000s for Kenya, Tanzania, Uganda and Zambia, finds evidence of positive bias in age at first sex for men (reported age at first sex increasing over time for a given cohort) but less of a clear pattern for women. These results point to the need for caution in interpreting behaviour trends from survey data; certainly, analysts should perform an investigation of these potential data problems.

Responses of fertility to HIV/AIDS

Fertility may also change in response to the epidemic, either through physiological changes in fecundity or through changes in fertility preferences and behaviour. Among women infected with HIV, fecundity is reduced for several reasons, including higher rates of miscarriage and stillbirth (Strecker *et al.*, 1993) and high rates of coinfection with other sexually transmitted infections, which may cause secondary infertility (Gray *et al.*, 1998; Martin *et al.*, 1991; Setel, 1995). Illness may also reduce the frequency of intercourse.

With respect strictly to behaviour, the desire for children may fall because of women's fears (whether they are knowingly HIV positive or not) of passing on the virus to their children, of not being alive to care for their children, or of their children contracting the disease themselves and dying (Gregson *et al.*, 1997; Setel, 1995). Reductions in fertility could also occur as a side effect of prevention behaviour, via reductions in unprotected sexual intercourse or increases in age at sexual debut.

On the other hand, other factors could lead to a positive fertility response to the epidemic. By slowing or reversing the trend toward lower child mortality and by increasing the risk that those children will die once they become sexually active, the epidemic may serve to increase the desired number of births. For the population as whole (not just the infected), Kalemli-Ozcan (2006) and others argue that in response to uncertainty about child survival, parents will choose to have more children (the precautionary demand motive), ultimately slowing or reversing the demographic transition in Africa. Among HIV-positive women, there may be a desire to continue to deliver children in order to appear healthy or avoid stigma. Parents who are infected or fear they may be may try to speed up the pace of childbearing to meet reproductive goals that are socially or culturally important (Temmerman *et al.*, 1994; Gregson, 1994).

Turning to the evidence, many African studies, both clinic and cohort based, indicate that total fertility or childbearing odds are lower among HIV-positive women (Allen *et al.*, 1993; Batter *et al.*, 1994; Ryder *et al.*, 1991; Carpenter *et al.*, 1997; Sewankambo *et al.*, 1994; Hunter *et al.*, 2003; Zambuko and Mturi, 2005). The relative importance of physiological factors, on the one hand, and behavioural responses to being HIV positive, on the other, in explaining these differences is not clear. With respect to fertility intentions, in a number of qualitative studies in Africa, women diagnosed with HIV express their intention of curtailing further childbearing (Setel, 1995; Gregson *et al.*, 1997; Ntozi and Kirunga, 1998; Rutenberg *et al.*, 2000), although one study from Côte d'Ivoire points instead to a desire to continue childbearing despite being HIV positive (Aka-Dago-Akribi *et al.*, 1999).

Several studies with HIV testing and follow-up of women use objective measures of fertility behaviour rather than reported intentions: pregnancies, births or contraceptive use occurring after diagnosis. This research generally finds that fertility and contraceptive behaviour does not change after a positive HIV diagnosis (Heyward *et al.*, 1993; Lutalo *et al.*, 2000; Temmerman *et al.*, 1990). It is possible that many women would have wanted to reduce their childbearing but were afraid to reveal their HIV status to their partners. Therefore, the relatively few prospective studies looking at actual behaviour following an HIV positive diagnosis are inconsistent with studies just noted suggesting that HIV positive women would like to reduce their childbearing. Note that they do not support the opposite hypotheses either, that fertility will increase.

To understand the impact of HIV/AIDS on fertility, it is necessary also to know if and how women who are not knowingly infected, adjust their fertility in response to the risks associated with the epidemic. It is worth recalling that the vast majority of women and men in Africa – and of HIV positive women and men – have not been tested, so they do not know whether they are infected or not.³⁸ In a Zimbabwe study (Gregson *et al.*, 1997), very few women said they intended to increase the number of children or accelerate their childbearing in response to the AIDS epidemic, while almost half indicated they would like to have fewer children and the same share

indicated they would like to wait longer before their next birth. Consistent with these findings, Noël-Miller (2003), using rural Malawi panel data, finds that women expressing significant worry about HIV risk were less likely than other women to have a birth in the three-year interval between surveys.

Noël-Miller's study is unusual in that it links fertility behaviour to prior subjective HIV risk perceptions. Also rare are studies that try to link fertility behaviour to variation in HIV prevalence or incidence. The challenges to doing so are essentially the same as noted above with respect to risk behaviour: first, the correlation of the HIV-behaviour relationship, and practices such as early marriage and the frequency of unprotected sex that increase fertility also increase exposure to HIV, and second, the need to account for the mediating effects of policies. Two recent cross-country econometric exercises that examine this issue, Young (2005) and Kalemli-Ozcan (2006), reach precisely opposite conclusions. Young's estimates, using DHS data from 27 African countries, indicate a negative effect of HIV national prevalence rates on individual probabilities of a recent birth and on total fertility. Kalemli-Ozcan, using a different but overlapping sample of countries and using aggregate country-level estimates of total fertility rates, finds a positive effect on total fertility of (depending on specification) HIV prevalence or incidence.

Unlike Young, Kalemli-Ozcan also attempts to instrument her HIV regressors. Since she finds the effects qualitatively similar to those using OLS as well as country fixed effects, it does not seem as if the different conclusions of these two studies are driven by the treatment of HIV prevalence as exogenous with respect to behaviour in Young's regressions.³⁹ Differences in country samples, in the use of aggregate versus individual level data or in the specifications used may be driving the disparity. These studies, it should be noted, estimate population level fertility impacts: since the data do not distinguish HIV positive from negative women, the estimates reflect a combination of biological and behavioural impacts and outcomes for HIV-positive women and for HIV-negative women. Together, these papers provide evidence at least, that the issue of the effects of HIV/AIDS on fertility at the population level is far from being sorted out.

Therefore the extent (and even the direction) of feedback effects from HIV/AIDS to reproductive choices as well as risk behaviours remains an important area of future research, with broad implications for the future of the epidemic and, as noted below, for economic growth and poverty. Further, while the effects on fertility of expectations about *own* mortality risk and that of one's children have been considered and debated, research has not considered another factor: the huge number of AIDS orphans who are added to the households of relatives of deceased parents. Given the prevalence of fostering, men and women will anticipate that (if they themselves do not succumb) they may end up taking in the children of deceased siblings or other relatives. Therefore, AIDS increases the expected number of surviving children in their households apart from effects via their own fertility responses, and one may expect this to reduce the desired numbers of own children. A key question is whether they consider the children they come to care for

to be equivalent to their own, in terms for example of future resource transfers from these children. Given evidence that fostered-in orphans receive less schooling than children of household heads, perhaps such children are not complete substitutes for own children. There still may be fertility effects, however, and this possibility needs to be considered.

Data requirements to appropriately address the impacts of the epidemic on fertility and sexual risk behaviours are fairly strong. To capture changes in behaviours, researchers need either longitudinal or repeated cross-section data with information on fertility or sexual activity. These data, which as discussed above should be subject to reliability checks, must be matched to information on local HIV prevalence, incidence or mortality. Repeated DHSs are a logical source of information on changes in behaviour, although a number of studies cited above also use smaller cohort samples. These can be matched to local antenatal surveillance site information on changes in HIV prevalence or to other sources of HIV data. It is anticipated that in the future the latter will include repeated rounds of DHSs or related national surveys with HIV testing modules.⁴⁰

Even with such data, of course, the researcher has to confront the correlation problem: Are observed behaviour changes the result or cause of changes in HIV prevalence? Several possibilities for instruments were noted above, but the validity of some of them is questionable. It is likely to be easier to predict the level of prevalence, as in these studies, than changes in prevalence over time. One is then measuring response to changes in HIV using spatial rather than intertemporal variation. In principle this can be done at the subnational, not just country, level, provided there is adequate variation in HIV data and instruments.⁴¹

Linkages with Poverty

Next we turn to the poverty side of Figure 10.1, starting with the effect of poverty on HIV/AIDS operating through reproductive health, behaviours and the use of services, as well as through other pathways. We follow this with a discussion of the reverse pathway, that is, the implications of the AIDS epidemic for poverty at both the macro or aggregate level and the micro (household and individual) level.

Pathways from Poverty to HIV/AIDS

First, what is the overall association of HIV/AIDS and poverty? At a global level, the association is positive. The countries most burdened by the disease – most of them in Africa – are among the poorest. This is assumed to reflect the association of a country's level of income with the quality of its health infrastructure and HIV awareness. At the micro level poverty potentially increases vulnerability to HIV via compromised reproductive health or reduced HIV/AIDS awareness. The poor are less likely than the wealthy to know about prevention behaviours and less likely to have had an HIV test. Glick and Sahn (2007) examine these associations using recent DHSs from nine African countries. Echoing earlier studies, they find and that

the effects of household wealth on both prevention knowledge and testing, estimated from probit models, tend to be positive, if not always statistically significant. The poor also have less access to, or ability to pay for, condoms, and may also be more likely to have untreated cofactor STIs that increase susceptibility to HIV infection. Another potential pathway from poverty to HIV is via overall poorer nutrition and health status. It has been hypothesised that these factors compromise immune defences or increase receptivity (via weakness in epithelial cells) to HIV infection (see Stillwagon, 2002).

Yet in spite of these factors, when one looks either within or across countries in Africa, HIV infection tends to be associated with greater wealth or income, not less. HIV prevalence is highest in the relatively wealthy countries of Southern Africa (e.g., Botswana, South Africa). Since there are many potential confounding factors at the national level, micro evidence is more compelling. A new and valuable source of information are several DHSs and AIDS Indicator Surveys (AIS) that gather HIV serodata linked to information on individual characteristics.⁴² These population (as opposed to clinic or antenatal site) HIV surveys have been made possible by the development of simpler testing technologies. Mishra (2006) reports on an analysis of eight such surveys (in Burkina Faso, Ghana, Cameroon, Uganda, Kenya, Tanzania, Malawi and Lesotho). His findings as well as some earlier micro level studies (see Wojcicki, 2005) indicate generally positive associations of HIV infection and wealth, the latter measured by the level of physical assets.

Why is a positive association of wealth and HIV observed? For one thing, the better-off tend to have more concurrent sexual partners. Since such relationships (whether casual or not) have a financial cost, this is not surprising: in economic terms, having multiple partners is a “normal” good. Glick and Sahn (2007) estimate ordered probits for number of partners for women and men in a number of African countries using DHS data. Among men, the estimated effects of wealth (controlling for education and several other factors) are not always significant, but where they are, they are usually positively signed. The same goes for the effects of level of education. For women the impacts of both wealth and education are more ambiguous, although the likely underreporting of the number of partners for women (see de Walque, 2006) make these estimates harder to interpret.

The wealthy also tend to be more geographically mobile than the poor – for example, the better-off within rural populations are more likely to travel regularly to urban areas – and such mobility is associated with the holding of multiple concurrent sexual partnerships. Less causally, HIV prevalence is higher in urban areas, which are also wealthier. Finally, the wealthy with HIV tend to survive longer than the poor. Their better nutrition keeps their immune systems stronger, and their superior access to health care also helps them deal with opportunistic infections. Hence they are more likely than poor individuals who are infected to show up in surveys and be recorded as HIV positive. This implies that the survey data may be overstating the actual association of wealth and HIV infection. On the

other hand, to the extent that being HIV positive leads to reduction in work and income, the association will be underestimated.

In the analysis reported by Mishra (2006), alternate logistic models of HIV odds were run with controls for factors such as occupation, rural/urban residence and self-reported risk behaviours. The positive association between wealth status and HIV becomes statistically insignificant in most cases when these potential confounders and mediating factors are controlled, but even then, wealthier adults in most of the country samples are no less likely than poorer adults to be HIV-infected. The reduction or elimination of the wealth effect is not surprising; as the previous discussion implies, we would not expect there to be much difference in HIV probabilities once we control for the factors, including sexual behaviours, that differentiate the wealthy and the poor.

The foregoing suggests several key research questions on the relationship of poverty and HIV/AIDS. First and most broadly, is there at some level a conflict between the goals of economic development and poverty reduction, on the one hand, and HIV prevention, on the other? The dilemma is that the process of growth and concomitant poverty reduction is typically associated with a range of factors – increased geographic mobility, income and urbanisation – that increase HIV susceptibility. Geographical mobility, for example, is not merely associated with, or an outcome of, wealth; it is often precisely the means by which individuals and families escape poverty, by moving for example to cities where economic opportunities are more plentiful. The evidence thus should cause us to doubt the popular view that the best way to reduce AIDS is to reduce poverty (see Fenton, 2004, and Shelton *et al.*, 2005, for discussion).

Related to this, should prevention efforts be targeted more carefully at somewhat better-off groups in the population? To what extent do the associations of wealth and seropositivity reflect direct “wealth effects” on the demand for partners as opposed to structural confounders such as urbanisation and access to transportation networks?

In terms of dynamics, how does the wealth–HIV (or poverty–HIV) relationship evolve over time as epidemics mature? It is worth noting that even in Uganda, with possibly the oldest epidemic and the highest level of HIV awareness, one still observes a positive association between wealth and HIV infection. This does not mean, however, that this relationship is static. There are indications, including for Uganda that the association of wealth and HIV weakens over time. This may be because of the natural spread of the epidemic beyond the initial (wealthier) affected population, or because the wealthier are in a better position to access or understand prevention messages and to act upon them, for example by being able to purchase condoms. The advantage of the better-off with respect to accessing and understanding information about health risk would be derived in part from their superior education. In line with this hypothesis, a micro level analysis in Masaka, Uganda, by de Walque (2004) indicates that while there was no significant

association of education and HIV seropositivity in 1990, by 2000 the association was negative and significant. For Zambia, a similar pattern is reported by Michelo *et al.* (2006). These findings suggest that the educated (and by extension, the better-off) are the first to receive prevention messages or to understand them, or both.

To address this dynamic issue requires panel or cohort data (repeated observations on a group of individuals) or else repeated cross-section data such as those used by de Walque in Masaka. The data must link individual characteristics such as education and assets to information on HIV status. Panels in particular could also address the correlational problems inherent in the wealth–HIV association mentioned previously. But even without panel data, thoughtful statistical analysis using cross-section surveys with linked HIV data will be able to clarify the links between poverty and HIV. This will be the case especially if these survey data can be further matched to data on local environmental factors such as access to transportation routes, population density, migration and industry. This would help illuminate the extent to which the association of wealth and HIV infection is causal in the sense of being due to behaviour that is a direct function of wealth (e.g., an increased demand for partners), or instead is largely a reflection of the correlation of wealth with structural economic factors such as residence and population density (which affect, among other things, the density of sexual networks and the supply of sexual partners).

The opportunities for such analysis should increase in the coming years as second round DHS/AIS cross-section data with HIV testing become available for many countries. This will permit analysis of changes over time, if not of the individual level dynamics captured in panels.

Pathways from HIV/AIDS to Poverty

The implications of the AIDS epidemic for African economic growth, and by extension, poverty, are not clear, especially with respect to the long term. Here we consider some of the possibilities for both macro and micro level impacts of HIV/AIDS on poverty.

Macro Level Perspectives

There are certainly many mechanisms through which the epidemic may have deleterious macroeconomic effects. Striking adults in the prime of life, AIDS depletes the ranks of workers, especially (given the evidence on the association of income and HIV) the relatively educated or skilled workers. There are many accounts of this process occurring in specific industries, as well as in the education sectors of hard-hit African countries. The latter implies a reduction in the supply or quality of schooling. On the demand side in the education sector, private investments in children's schooling by households hit with AIDS illness or death are expected to fall. These demand and supply side effects in education imply negative intergenerational trends in human capital, reducing future growth. Faced

with escalating turnover and training costs, as well as surging health care expenditures for sick employees, both local and foreign firms may reduce investment or pull up stakes altogether. Public sector budgets will be strained by the need to increase spending on care for those with AIDS-related illnesses, reducing allocations for development-enhancing expenditures in health and other areas.

Despite these considerations, cross-country regression analysis on data through the mid or late 1990s (Bloom and Mahal, 1997; Dixon *et al.*, 2001) found either no statistical effects of HIV prevalence on (per capita) economic growth or ambiguous effects. However, future impacts may be very different. Here, predictions based on simulation modelling diverge considerably. Initial studies yielded what might be regarded as relatively optimistic predictions, on the order of perhaps a 1 per cent annual reduction in growth (summarised in Bell *et al.*, 2003) – far from trivial in the context of Africa's already typically very low growth rates, but not devastating. Further, such first generation models tend to show little decrease, or even an increase, in per capita GDP growth, because HIV-related declines in GDP are offset by increased mortality and population decline. Moreover, in a traditional Solow-type growth framework, reductions in growth are dampened by the fall in the supply of labour relative to capital, since this increases the productivity of labour. A recent similarly optimistic set of projections has been put forth by Young (2005), who as noted earlier emphasises a different mechanism, that of reduced fertility in response to the epidemic. The reduction in the dependency ratio increases per capita consumption as well as savings, potentially increasing economic growth as well as providing the resources to care for those with AIDS.

Others are far less sanguine, however. The important work by Bell *et al.* (2003, 2004), for example, yields a much grimmer picture. Their model emphasises a different behavioural response: a large reduction in investment in the human capital (schooling) of children as a result of AIDS-related illness and mortality, which occurs both because households are poorer and because the returns to such investments have fallen. The cumulative result of reductions in human capital investments is a large decline in GDP.

Other pessimistic projections, including many less formal assessments, often emphasise less tangible implications of the epidemic. These include effects on children's socialisation and the fraying of social safety nets; the disruption of firm and government operations through high turnover and the thinning of workforces; and consequent reductions in profitability and in the incentives of firms and households to invest and to save. A more general result is the deterioration in the functioning of a range of public and private institutions. Especially in Southern Africa, there is evidence that some of these effects are already occurring. At least, personnel losses of magnitudes that are potentially devastating have taken place, as documented by Husain and Badcock-Waters (2002).

In their review of a recent collection of papers on the subject (Haaker, 2004), Arndt (2006) notes several important gaps in the topics addressed that could equally apply

to the literature as a whole. One is the lack of attention to how macroeconomic impacts may vary depending on the level of development and economic structure – for example, whether the agricultural economy is land or labour constrained, and whether the economic infrastructure and supply of key services such as education are well developed or not. A second is a lack of modelling directed at understanding the implications of expanding ARV provision. While there is little direct evidence on how long the drugs will prolong life in the African context, evidence from a (less) poor, non-African country, Brazil, suggests a median time of perhaps four years (Marins *et al.*, 2003).⁴³ Even this relatively limited delay may have significant implications for family incomes, children's schooling and health, and hence national income. On the cost side, implementation of scaled-up ARV programmes will also impose significant burdens on governments, even if the drugs themselves are financed by donors. An exception to this gap in the literature is Young (2005), whose macro modelling does incorporate the effects of ARV provision on life expectancy.

The main problem with efforts to model the macroeconomic implications of AIDS in Africa is that projections hinge crucially on assumptions made about micro-level behavioural responses of individuals as well as firms, with respect for example to fertility, schooling investments and sexual risk behaviour. This is brought out clearly by the comparisons of the widely divergent outcomes of several of the analyses. This is often not merely a matter of whether different parameter values are imposed for specific responses, but instead whether these channels are modelled at all. As Bell *et al.* (2003) note, earlier efforts based on a simple Solow-type framework emphasise the aggregate growth of labour and physical capital; such models ignore responses of human capital investment and hence the reduction in the transmission of human capital across generations. Most models do not incorporate changes in fertility and in investments in physical capital by households. Excluding specific channels or responses, of course, is equivalent to assuming zero response. Ultimately, learning more about these behaviours is essential, which takes the focus back to the micro level.

Micro/Household Level Perspectives

Many studies, both qualitative and quantitative, have investigated the effects of AIDS on poverty and other outcomes at the household level. The main areas of focus for this research have been the impacts of an AIDS illness or death on household income and consumption, on household structure (or dissolution), and on children, in particular, children's schooling.

Effects on Household Consumption, Production, and Demographic Structure. Pressure on the consumption levels of AIDS-afflicted households may come through reductions in labour supply, incomes and farm production, as well as through the burdens of health care expenditures for the ill and funeral costs for the deceased.

Methodological Issues. Most of the studies examining the levels of consumption and production impacts of AIDS-related illness or death have used panel data (data on the same households collected at different points in time).⁴⁴ However, several rely on retrospective questions about mortality in cross-sectional data and use them to make simple comparisons of afflicted and non-afflicted households. In at least one case, only AIDS-afflicted households were identified for interview.

Panel data are far superior for examining this issue. Some studies have made use of such data to condition the estimates of mortality impacts on baseline characteristics of the households, in particular, income or assets. As noted above, AIDS mortality in Africa appears to be selective, on wealth in particular. Including wealth and other baseline characteristics in regressions of household outcomes on mortality allows the estimation to control for differences in these factors between households experiencing deaths and other households. However, households may also be heterogeneous in terms of unmeasured factors that affect both adult mortality and consumption or other outcomes of the household. For example, it may be that, conditioning on wealth and education, adults who are more likely to become infected with HIV (because they lack health and prevention knowledge, because the male spouse visits sex workers, or because they are less concerned about the future), are also less likely to allocate resources towards consumption or children's health and schooling. AIDS illness and mortality are then correlated with outcomes of interest even after we control for observable characteristics, so their inclusion in the regression is not sufficient to eliminate biases.

Therefore many analysts using panel data employ differencing or fixed effects methods. Here, one regresses *changes* across periods in household consumption (or some other outcome) against *changes* in the right-hand side variables; for mortality, the change over time is simply an indicator of whether someone has died in the interval. With this approach the influence on the outcome of any unobservable factor that might be correlated with mortality subtracts out. This is, however, subject to the assumption that the unobservables affect the *level* of the outcome, but not changes in the outcome over time; the household fixed effect, in other words, must be time-invariant.

This assumption may not always be valid. Some of the more likely violations have to do with investments in children's human capital, the subject of the next subsection, but the concern is also relevant to the outcomes considered here. It is possible that households that experienced an AIDS death would have experienced different growth paths for assets or consumption than other households in any case, or would have undergone different changes in family structure. These differences will likely not be very important when considering short-term mortality impacts, but will be a source of bias, if present, for fixed effects estimates of longer-term impacts.

One other point about panel data is that the appropriate baseline information pertains not to the period immediately prior to death, but to the period prior to when the individual become ill with AIDS. One requires an adequate interval in the panel to capture this change. There is also a standard problem of attrition in panel data (see Alderman *et al.*, 2001). Households and individuals are mobile so many may be lost to follow-up. Given the possibility that an AIDS death leads a household to migrate or dissolve, selection on mortality may seriously bias many of the estimates in the literature that do not have information on those who leave the sample. For analysis of the effects on children the concern is especially important given the possibility that a child may be sent away to live in other households following the death of a parent. We return to these problems following.

A very different methodological challenge is distinguishing, in the absence of clinical information, deaths due to AIDS from deaths due to other illnesses. The simplest and most common approach is not to try: One can simply compare households experiencing an adult death from any cause with households not experiencing a death. This is clearly not the ideal method but it requires the least information and can be used with many standard surveys. Further, overall adult morality rates from surveys appear to correlate well with regional AIDS prevalence (Mather, Donovan, Jayne *et al.*, 2004), and where AIDS mortality is very high, it will likely account for most prime age adult deaths. Still, the effects of AIDS illness (which is of long duration) and death are likely to be more severe than for other sources of mortality, raising the possibility that analysis which aggregates the two will underestimate the impacts of AIDS deaths specifically. Therefore some researchers use proxies such as duration of illness to assign AIDS deaths. Many others opt for a more thorough (and skill-intensive) approach, known as the verbal autopsies method (see Kamali *et al.*, 1996; Garenne and Fauveau, 2006), through which interviews with family members or caregivers about the illness and symptoms of the deceased are used to ascertain the cause of death.

Finally, a problem with empirical analysis of the effects of prime age adult mortality is the relative rarity of these events. In areas of very high HIV prevalence, mortality will also be high, but in other settings the small number of recent deaths recorded in the data may mitigate against finding statistically significant effects. This needs to be kept in mind when reviewing this literature. Considerations of statistical power therefore point to a significant advantage of large (and expensive) surveys over smaller more focused ones, unless the sampling procedure was such that households experiencing a death are over sampled. A rare example of this is the Kagera Health and Development Survey (KHDS) in Tanzania.

Evidence on the Effects of Mortality on Households. Most studies of the effects of AIDS mortality find that overall household income or expenditures fall in afflicted households while at the same time the composition of spending shifts sharply towards medical care and funerals. The latter burdens are typically very significant. Among Tanzanian households suffering an AIDS illness and death, the sum of medical and funeral costs on average exceeded the estimated annual household

income per capita in the population (Ngalula *et al.*, 2002). This burden is not atypically high. A study of South African households, for example, found annual AIDS-related medical costs and funeral expenses each comprising about a third of household annual income (Steinberg *et al.*, 2002). The burden of health care expenditures from AIDS tends to be larger than for other terminal illness or injury because, as just noted, the duration of illness is long (Menon *et al.*, 1998; Ngalula *et al.*, 2002). Some studies document reductions in household physical assets as well as incomes (Menon *et al.*, 1998; Mushati *et al.*, 2003).

While these studies document significant burdens associated with adult illness and death, the effects on per capita household income and consumption from the loss of the adult, especially in the long term, are not as clear. In an analysis of the Tanzania KHDS (World Bank, 1997) it was found that households with a prime-aged adult death in the last year had 7.5 per cent lower expenditures (per adult equivalent durables) than households without an adult death. This is perhaps a surprisingly modest reduction in income (although consumption would have fallen by more since expenditures had to be allocated to funerals or medical care). It should be noted that the comparison does not control for initial household income, which may have been higher in AIDS afflicted households given the associations noted above of wealth and HIV infection.

Beegle *et al.* (2008) are able to take advantage of subsequent waves of the KHDS panel to control for differences among households in adult mortality. They consider the effect of a prime-age adult death on subsequent growth in household per capita expenditures using data covering the period 1991 to 2004. Their specification is differenced across time, i.e., they use household fixed effects to control for fixed unobservables affecting mortality over the period.

The estimates indicate that a death leads to 7 per cent lower consumption growth during the first five years after the death, with recovery after that but not to pre-death levels. As Strauss and Thomas (2008) point out with reference to this study, a 7 per cent decline in consumption is not trivial, but is small in comparison with the household impacts of some macroeconomic shocks in developing countries. They note as well that such relatively modest impacts at the micro-level seem to belie the claims of many that Africa is in danger of massive economic failure due to AIDS. To some extent, however, these claims rely on general equilibrium or institutional effects that are not captured in micro data, or perhaps that are not yet realised. For example, extreme negative consumption impacts on surviving family members may be avoided through transfers from the extended family or community. But if AIDS mortality reaches a certain threshold in the community, this support network may eventually fail. There is little evidence on these issues, but research that has been done is discussed briefly following:

Perhaps the firmest conclusion one can make from the research conducted to date is that there is considerable heterogeneity in the severity of the effects of an adult death. Among other things, the position of the deceased in the household will

strongly condition the welfare consequences. Mather, Donovan, Jayne *et al.* (2004), summarising five East and Southern African country studies, note that it is not always the case that the individual who dies is either the household head, the primary breadwinner or the wife of the household head. Most females who died were not wives of household heads (or household heads themselves), and even for males the patterns were mixed. Where the deceased did not have one of these roles, the income impacts are relatively small. In other cases, such as poorer families headed by HIV widows, the negative consequences may be quite severe. In contrast to these studies, Beegle *et al.* (2008) do not find a relationship between a household's initial level of welfare and the consumption impacts from an adult death.

Along with consumption patterns, household production patterns may change as a result of an AIDS illness or death. It was initially widely assumed that among agricultural households, labour shortages from AIDS mortality would lead to a shift to less labour-intensive crops (Topouzis and du Guerny, 1999). Empirical research, however, again primarily using longitudinal data, indicates that responses vary widely, depending on the agricultural or regional context, the initial level of household wealth, and who in the household has died (see Gillespie and Kadyala, 2005, and Mather, Donovan, Jayne *et al.*, 2004, for a discussion of the literature).⁴⁵ Barnett *et al.* (1995) present evidence of Ugandan households shifting farming activity away from high value cash crops towards crops for own consumption. For rural Kenya, Yamano and Jayne (2004), using household fixed effects, find no change in area devoted to food crops after an adult death but a large reduction in area allocated to cash crops such as coffee and tea if the death is of a male head of household.

In other settings, changes in cropping patterns are less evident. Beegle (2003) found that there were few changes in the labour supply of surviving individuals in rural Tanzanian households a year after a prime-age adult death. Nor did these households shift cultivation towards subsistence food farming or reduce their diversification. Similarly, for Rwanda, Donovan *et al.* (2003) find that death-affected households have few significant differences in crop production patterns from similar (based on propensity score matching) non-affected households, although the amount produced tends to be smaller in afflicted households.

This literature also indicates that production responses are tightly wound up with changes in household structure resulting from an AIDS death. This is not surprising, since such changes will determine what happens to total household labour supply and its composition. Findings are varied here as for other responses. In the Kenya study by Yamano and Jayne (2004), deceased adult members were not replaced: households and total labour supply got smaller. The same was found in rural Mozambique (Mather, Donovan, Weber *et al.*, 2004). In contrast, Rwandan households were able to maintain their labour supply through the addition of new members via marriage or through the addition of young relatives (Donovan *et al.*, 2003).

The most dramatic – and clearly, not necessarily voluntary or desirable – change in household structure is the dissolution of the household unit itself, as survivors move in with relatives or (in fewer cases) become destitute. Understanding this process, and in particular the effects on the welfare of persons in households that dissolve, raises challenges for empirical researchers. In cross-section household survey data, one obviously does not observe such households; one only observes existing units that reflect post-death reallocations of family members among other households. Indeed, this is a potential problem for much of the analysis reviewed in this section – and longitudinal studies face a similar problem. Panel studies of the effects of an AIDS death on surviving family members typically measure these outcomes only for individuals in families that remain intact and in the panel. It may well be that individuals from dispersed households are worse off.

To learn about household dissolution when only cross-section data are collected, some studies have used retrospective interviews with individuals about their recent histories. This will provide information on, for example, the share of persons who have experienced AIDS deaths in their families and subsequently suffered the break-up of their households. It will not provide information on associated changes in consumption and nutrition, although as discussed in the next section, one could fairly easily gather information on children's previous and current school status. With longitudinal data, changes in household composition and existence can be traced from the baseline roster information on households. For AIDS or mortality-affected households that disappear by the time of follow-up, it will not be evident whether they dissolved or moved away, but typically, at least in rural areas, this information can be obtained from neighbours or community leaders. However, it will be difficult or impossible to learn about changes in consumption, health and schooling experienced by the individuals in such households.

Turning to the evidence on the sources of household dissolution, a large-scale longitudinal study of rural South Africa (Hosegood *et al.*, 2004) found that households in which an adult had died from AIDS (5 per cent of the sample during the one-year study period) were three times more likely to dissolve than those where no deaths had occurred. Households that were initially poor were more likely to dissolve following a death. In another large panel survey, in eastern Zimbabwe (Mushati *et al.*, 2003), 10 per cent of households dissolved between 2000 and 2003 and 24 per cent had moved; again the probability of dissolution was higher for households experiencing an adult death. The threat of dissolution (and the likelihood of migration) is often larger for women whose spouses die rather than for men whose wives die, both because the loss of income may be greater and because of legal or traditional barriers to women's right to inherit land and other assets (Urassa *et al.*, 2001; Shah *et al.*, 2001). In some studies, household dissolution following an adult death was relatively uncommon. In panel data from Kenya, Malawi and Rwanda, relatively few such households were observed to break up, reflecting the fact that, as noted above, in these contexts adult deaths from AIDS

did not usually involve the main family breadwinner (Mather, Donovan, Weber *et al.*, 2004).

Effects on Children and Investments in Human Capital. A great deal of attention has been given to impacts of AIDS illness and mortality on children, both because of direct concern about their welfare and because AIDS-related reductions in child schooling and health investments have negative implications for future economic growth. It is estimated that about 9 per cent of children under 15 in Africa have lost one or both parents to AIDS, and that one out of every six households with children in the region is caring for at least one orphan (UNAIDS, 2006). Double orphans – children who have lost both parents – are almost always taken in by their extended families (Monasch and Boerma, 2004). By and large it appears that this traditional safety net mechanism has performed very well in the AIDS epidemic, holding at bay the outright destitution of countless children. This does not mean, however, that orphaned children or children in AIDS-afflicted households do not suffer serious negative consequences.

Methodological Concerns. Researchers attempting to understand these impacts face methodological challenges similar to those described above for other micro-level outcomes. Much of the initial work on this topic used cross-section data and compared the nutritional status and (more often) school enrolment of orphans with those of non-orphans⁴⁶ (Lloyd and Blanc, 1996; Ainsworth and Filmer, 2002; Bicego *et al.*, 2003). There are several issues to be aware of regarding such analyses. The counter facts for understanding the effects of AIDS mortality is the outcomes that would be faced by orphaned children in the absence of their parent(s)' illness and death. Most analyses using cross-section data compare the mean nutrition, schooling or per capita household consumption of orphans and non-orphans, that is, the outcomes for the latter are used as the counter facts.

With a nationally representative survey, this comparison would accurately portray differences in current outcomes for the two groups, information that may be valuable from a targeting perspective.⁴⁷ But it does not indicate the *effect* of orphanhood – say, the loss in welfare measured by nutritional status or household per capita consumption – unless being orphaned is random with respect to other factors contributing to welfare. This is a very unappealing assumption; for one thing, as discussed earlier, in Africa AIDS mortality is generally associated with greater wealth.⁴⁸

Several authors using cross-section data therefore differentiate within households so as to control for unobservables at the level of the household (Case *et al.*, 2004; Yamano *et al.*, 2006). These household fixed effects⁴⁹ estimates compare outcomes such as health and schooling of orphans and non-orphans in the same household. Yet even if non-orphans fare better than orphans on these measures, the difference does not indicate the change in outcomes for the latter as a result of the loss of the parents. This problem can be discerned most clearly for children who have been fostered into new households after their parents or parent died. The characteristics

of originating households prior to the death of the parent(s) may differ systematically from those of receiving households in ways that affect human capital outcomes. There is some evidence, for example, that orphaned children tend to be sent to live with relatively affluent relatives who can most easily bear the added burden; Ksoll (2006) indicates this to be the case for Tanzania. Children in those families would then tend in any case to have more human capital than the incoming children, so do not form the appropriate comparison group.⁵⁰ The assumption that they do underlies the household fixed effects approach, which therefore may yield misleading findings with respect to the impacts of orphanhood.

On the other hand, the within-household comparisons may indicate whether or not orphans are discriminated against relative to other children in the household, who will be more closely related to the household head (Case *et al.*, 2004). If discrimination is taken strictly to mean caregivers' preferences for their own or more closely related children over orphans, this too requires certain assumptions. There may be lagged effects on children's human capital as a result of deprivation or emotional scarring from the illness and death of the parent(s), so that orphans have lower health status or cognitive ability to start with. If this reduces the returns to schooling investments, caregivers may provide less education to orphans than to more closely related children even if they would not otherwise tend to favour the latter.

Panel data avoid the central limitation of cross-section analysis: they permit observation of actual changes in individual children's health, schooling, or other outcomes after a parent or other adult becomes ill and dies. Baseline data permits the researcher to control for wealth and other initial characteristics of the orphan's household, something that is not possible in cross-section data on orphans. Alternatively, as with the panel analysis of the impacts of mortality on consumption, fixed effects – in this case, child-level fixed effects – can be used to eliminate the impacts of observed as well as unobserved factors that influence both adult mortality and children's outcomes. Yamano and Jayne (2005), Evans and Miguel (2004), and Case and Ardington (2005) take this approach, which in essence compares changes in outcomes for children who are orphaned with changes for other children to yield a difference-in-difference estimate of orphanhood effects. If the panel is long enough, it is possible to model the effects of parental illness and subsequent parental death, both relative to the appropriate baseline of the pre-illness period. Cross-section comparisons of orphans and non-orphans, whether descriptive or using household fixed effects techniques, only indicate (imperfectly) the impact of parental death.

Researchers using panel study designs do face the problem of the loss of information at follow up for orphans who are fostered out or whose households dissolve or migrate. It will usually be impractical to locate all such children, although for children fostered out of intact households one may still learn from remaining household members about their current schooling, if not their nutritional status or receiving household income. This is the case for the study by Yamano and

Jayne (2004), whose panel of rural Kenyan households collects information on the schooling of children who have left the household, even though information is lost on children in households that move or dissolve (these events, however, are relatively rare). Beegle *et al.* (2005) report on a follow up to the KHDS, in Kagera, Tanzania, that ambitiously attempts to trace children initially surveyed some 10–13 years earlier, even if the children had left their baseline villages. Failing this rather substantial effort, one can attempt to bind the effects on the estimates caused by attrition resulting from household dissolution, migration or other factors (Manski, 1995, and Evans and Miguel, 2004, apply this idea). Of course, if attrition is significant the range in the estimates will be correspondingly large.

Another problem, noted in the last subsection, is that the assumption of time-invariant fixed effects may not be valid. Differentiating eliminates bias from unobservables that affect both mortality and the levels of child outcomes such as schooling and health. It is only valid if changes in child outcomes – for example, changes in school enrolment status – are not similarly correlated with unobservable factors that affect HIV risk and mortality. Yet it is not hard to imagine how this correlation can occur. Suppose, for example, that conditional on observed characteristics, parents whose behaviours put them at higher risk of HIV/AIDS (because of lack of health knowledge or concern about the future) also tend to invest fewer years in their children's schooling. Then, even in the absence of a death, changes in the schooling status of the children would be different from that of children in other households: they will be more likely to have left school. Rather than differencing away, these factors influence the change in the outcome, and the negative effect of mortality on schooling will be (in this example) overstated.

The more general problem is that both schooling and health status are realistically characterised as outcomes of cumulative processes. Current school enrolment (or academic performance) depends in part on prior school status and performance; the latter, for example, will determine whether a child is promoted and perhaps also the willingness of the parents or child to continue. Similarly, certain measures of child health, such as height-for-age, capture the cumulative impacts of prior nutrition and health stresses. This means that unmeasured factors affecting initial levels of these outcomes will also affect how they evolve over time. If these factors are associated with mortality, differencing will not eliminate the bias in the estimates of mortality effects.⁵¹ As with the estimation of the effects on household income and structure, this will be less of a concern when considering short-term mortality impacts than when estimating longer-term impacts.

Evidence of the Effects of Parental Illness and Mortality on Children. Turning to the results from this literature, cross-section analyses for Africa (often using DHS data) generally find lower school enrolments and poorer nutritional status among orphans than among non-orphans (Monasch and Boerma, 2004; Case *et al.*, 2004). On the basis of household fixed effects estimates, Case *et al.* conclude that lower orphan schooling does not represent merely an association of orphanhood with low (current) household income, as several earlier researchers argued (e.g., Lloyd and

Blanc, 1996). Rather, orphans are discriminated against in favour of children in the same household who are more closely related to the household head. Therefore they represent a particularly vulnerable group potentially needing targeted assistance. The degree of schooling disadvantage is a function of how distant the relationship is between the orphan and the caregiver, suggesting that “true” (preference-based) discrimination based on relatedness is at work, not lower returns to investments in orphans arising from prior deprivation (or at least, not only lower returns).

Yet, cross-section studies do not always find negative associations of orphanhood and welfare outcomes. Ainsworth and Filmer (2002) report diversity in orphan/non-orphan differentials across countries and argue that generalisations about orphan disadvantage are not warranted.⁵² Chatterji *et al.* (2005) in studies on Rwanda and Zambia find that among children 6–12 years old at the time of the survey, orphans actually have a higher point estimate of the probability of being in school than other children, although the difference is not statistically significant, while among 13–19-year-olds, orphans are less likely to be in school, but this difference, too, is not significant. Lindblade *et al.* (2003) finds similar health status of orphans and non-orphans under age six in western Kenya.

Given the difficulties in interpreting orphanhood effects from cross section data, as noted above, studies using longitudinal data are of particular interest. Evans and Miguel (2004) find negative schooling effects of orphanhood in their five-year panel data of children in Kenya. Impacts are very large for maternal deaths (a 9 percentage point fall in enrolment probability relative to non-orphans). Negative effects, but smaller, were also found for maternal illness preceding death. These child fixed effects estimates of orphanhood are substantially larger (more negative) than estimates obtained on the same data without accounting for individual fixed effects, i.e., cross-section estimates. This suggests that previous cross-section studies tend to understate the impacts.

Using different panel data from Kenya, Yamano and Jayne (2005) are also able to study impacts on individual children over a five-year period. Without controlling for mortality selection, they find significant negative impacts of adult death on school enrolment among poor children and for both boys and girls, but when child-level fixed effects are used; there is a negative effect only on girls. Their data, it should be noted, does not allow them to distinguish between parental deaths and other adult deaths in the household, and we might expect the impacts of the former to be stronger. Case and Ardington (2005), using a 2–3-year panel survey from South Africa and child-level fixed effects and other methods, report a negative effect of mother’s death on children’s education outcomes but no significant effect of father’s death.

Ainsworth *et al.* (2005) use the first several years of KHDS data from Kagera, Tanzania, to estimate the effects of a recent parental death. They use standard OLS or probit models to estimate impacts on school enrolment and child fixed effects to estimate impacts on hours attending school. They find that enrolment was delayed

for maternal orphans and for children in poor households where a parent died, but children 7–14 already in school who lost a parent were not more likely to drop out than other children. However, enrolled girls sharply reduced their hours in school after losing a parent.

Finally, Beegle *et al.*'s (2005) unique study using subsequent waves of the KHDS (see above) finds long-term, that is, essentially permanent, negative effects of the loss of parents. By the time they reach adulthood, maternal orphans are on average two centimetres shorter and schooled one year less than they would have been had they not been orphaned. Unlike the panel studies just mentioned, Beegle *et al.* do not use individual fixed effects to deal with household or child level unobservables affecting both orphanhood and schooling and health; instead they include a range of baseline covariates to control for (observable) factors that may correlate with later orphan status. While this leaves their estimates vulnerable to contamination from unmeasured factors, they show that subsequent orphanhood is not correlated with initial schooling and health of the children. This suggests that unobservables correlated with health and education are not correlated with becoming an orphan in the future.

These panel data studies therefore do suggest significant negative consequences of orphanhood, and that losing a mother may be more harmful to child's health and education than losing a father. The latter result is consistent with a greater role for mothers than fathers in various aspects of child development. Some evidence also suggests that school-age daughters are harder hit than sons. We can sum up these findings by saying that informal social safety nets in Africa, as essential as they are for insuring the welfare of children suffering parental illness and death from AIDS, do not appear to fully insure against these shocks.

Other impacts. There are several related issues that research has not addressed or has only just begun to examine. One is whether, as many have raised concern; informal safety nets will be stretched to the breaking point as adult mortality from AIDS rises, as it will continue to do in many countries in Africa. The rural Kenya study by Evans and Miguel (2004) mentioned above is one of the few to try to address this question statistically. They find that the proportion of children who have been orphaned in the community does not affect the likelihood of school participation, either for orphans or non-orphans, implying that in this setting mortality and orphanhood have not reached such proportions as to weaken traditional support systems.

Evans and Miguel's finding for non-orphans addresses in part the issue of the effects of parental death on *other* children, in particular, children in households that care for orphans. One might well expect negative externalities: An orphaned child represents a negative resource shock to the receiving household that would be expected to reduce per capita consumption and schooling and health investments for all members, even if it is the case that orphans are allocated fewer resources than own children. Note that if only cross-section data are available, to assess this

impact one is essentially comparing children in households that have not suffered an AIDS death and have not taken in orphans, on the one hand, with non-orphaned children in households that are caring for a child orphaned by AIDS, on the other. Hence familiar issues arise with respect to the equivalence of two groups of households, specifically the problem of non-randomness of the selection of caregiving households.

To date there appear to be only two studies that have considered these impacts. Evans (2005) conducted a careful cross-section analysis of DHS surveys from 26 African countries. He attempted to deal with the selection problem in several ways, including instrumental variable techniques (using reported death of a woman's sibling as an instrument for her household receiving an orphan) and matching techniques. The estimates indicate, contrary to what many would expect, that there is essentially no negative health or schooling spill over effects on recipient household children as a result of caring for a double-orphan child. The health of adult women in such households (measured using body mass index) similarly is not negatively affected. Possible reasons for these findings are that caregiving households tend not to be particularly vulnerable economically to begin with, and further, that they tend not to have children of the same age as the incoming orphans.

The other study, a longitudinal analysis of Uganda by Deininger *et al.* (2005), comes to rather more pessimistic conclusions. These authors consider the effects of a household receiving a foster child during the period covered by their long panel (from 1992 to 2000). More than 15 per cent of households received a child during the period. The results show that the addition of a foster child resulted in significant reductions of per capita consumption, income and household investment (measured as the change in physical assets) and these effects were more pronounced for the poor. Fostered children themselves were found to be disadvantaged relative to other children in the household, but in terms of school enrolments, this disadvantage eventually disappeared with the implementation of Uganda's universal primary education programme during this period, which largely eliminated enrolment fees. Like many other issues, the nature and extent of spillover effects of AIDS mortality and orphaning require additional research, especially using panel data.

Even less is known about the implications for children of providing anti-retroviral drug therapy (ART) to adults with AIDS. The impacts of ART on household incomes and other microeconomic outcomes are also largely unresearched. To date the only econometric analysis of these issues comes from an ARV programme in rural Western Kenya (Goldstein *et al.*, 2005, 2006). ART patients were followed from the time they began the regimen to up to one year afterwards. Large improvements in patients' health indicators as well as their labour supply were observed. In sync with these changes, children in the households of the treated individuals experienced large and significant increases in school attendance (an increase in hours per week of 20 per cent) as well as in an indicator of short-term nutritional status. In lieu of the appropriate control group (which would be children of AIDS-afflicted parents who did not get treatment) the researchers use orphans

from a random sample of households in the catchment area, who presumably more or less represent what the situation would eventually be for the children of treated parents if they did not receive the drug therapy. Difference-in-difference estimates using these children as the control group suggest even larger gains for the children of treated parents than the estimates not controlling for trends.

This initial research therefore indicates that there are substantial beneficial externalities to households and children from supplying ARVs to adults with AIDS. However, the study has (so far) only reported on short-term benefits. As noted earlier, first-line drug therapies, which are all that is widely available now in Africa, are currently expected to extend the life of AIDS sufferers for several years. The question is whether the gains for children evaporate after that time. To some extent, the benefits, with respect for example to the health of young children, are cumulative and therefore will have lasting effects even if households later suffer from declines in living standards. Still, the long-run benefits of scaling up ARV distribution remain unknown. This is hardly surprising in view of the recent introduction of these drugs, but it is important that the question be given a high priority in future research.

Finally, the literature on the health and schooling of children orphaned by AIDS (and the impacts on households that care for them) does not deal with broader possible effects of Africa's AIDS epidemic on human capital investment. What are the effects in families not (or not yet) directly affected by AIDS? Analogous to the discussion above on fertility impacts, changing expectations about one's own mortality and that of one's children should condition decisions about investing in the children's health and schooling, even among households not currently afflicted by AIDS. A standard economic model of human capital investments would predict the negative effects of the epidemic. A lower expected lifespan for children reduces the return on investments in their education: each additional year of schooling yields a smaller increment in total lifetime earnings compared with someone with a normal (i.e., pre-AIDS) expected lifespan. Further, since parents themselves are more likely to die young, the old-age security motive for schooling one's offspring (that better educated children will earn more and thus provide more transfer income) is diminished.

Research approaches to this issue will necessarily be different from those used to estimate schooling effects on individuals or households directly affected by AIDS; they will look more like the analyses of fertility responses to the epidemic discussed above. In fact, the authors of the two existing cross-country econometric studies of the effects of HIV prevalence on fertility, Young (2005) and Kalemli-Ozcan (2006), also analysed school enrolment effects. Just as is the case for fertility, Young finds a positive effect and Kalemli-Ozcan a negative effect, the question is important but the answer remains elusive.

Conclusion

This chapter has considered the linkages between poverty, reproductive health and behaviour, and HIV/AIDS in Africa. It has presented evidence on what research to date has revealed about these links, identified gaps in knowledge requiring further research and discussed methodological approaches to these questions. Given the diversity of the subjects covered and the sheer size of the empirical literature investigating these issues, it would be very difficult to sum up the discussion in any concise way. Instead, in view of the emphasis on practical guidance for researchers, we will highlight several salient points with respect to conducting research in these areas.

The first is that using an appropriate methodology and study design is crucial. A main theme of this chapter has been the need to account for the phenomenon of selectivity or non-randomness: in the use of services, in the placement of programmes, in HIV infectivity, in fertility and sexual risk behaviours, in orphanhood and orphan caregiving. Where individual behaviour and preferences are at issue, selectivity looms large. Much of the discussion in the chapter has dealt with how researchers can overcome the problem, and the limits of different kinds of data and techniques for doing so. With regard to data, there are many good reasons to collect more panel data in Africa. In particular, such data offers more ways of dealing with the selection issues that are a barrier to better understanding of the impacts of HIV/AIDS at the household level. Panel data sets are more common now in Africa than a decade or two ago; at least four such studies have been carried out in South Africa alone. Elsewhere in Africa, however, panel data collection is less common, if increasing.⁵³

Secondly, it is relevant to note that enormous resources are being allocated to HIV programmes in Africa, from prevention interventions to ARV provision. This of course is a reflection of the seriousness of the problem and the commitment of donors and governments to finding solutions. It provides opportunities for researchers that may be lacking in other areas. Certainly, few individual African (or for that matter, Western) researchers or social science research groups would have access to the resources necessary for evaluation of many of the interventions discussed in this paper. Further, many HIV-related interventions also involve the provision of medical services that obviously are beyond the scope of what social scientists do. However, many such interventions are under way or planned in African countries, by ministries of health or education, by NGOs, and by donors. Social science researchers potentially could link up with these efforts to contribute to the evaluation of outcomes and, even better, to help in the design of the evaluations. The inclusion of economists or demographers in this process would help to expand the range of behavioural outcomes to be considered. Economists and demographers are also particularly well placed to undertake the population-based sampling and statistical analysis required to understand the demand for and population level outcomes of various HIV or reproductive health care services.

Third, it nevertheless remains the case that many or most researchers will not be involved in either evaluating specific programmes or conducting policy experiments; most will probably also not be collecting original data. Instead, they will come to existing data sources with specific research questions. This report therefore has also emphasised how researchers can exploit secondary data sources to address important questions on reproductive health, HIV/AIDS and poverty. In particular, the range of subject areas that have been considered and analytical methods used with the Demographic and Health Surveys is close to astonishing. There is plenty of scope for imaginative and informative work with these data, including by matching them to other sources of information on the policy and economic environments. These data and related surveys, like the AIDS indicator surveys, will become even more valuable in the future as more of them include nationally representative information on HIV status.

Notes

1. Throughout this paper “Africa” is used synonymously with “sub-Saharan Africa”.
2. HIV incidence refers to the rate at which new infections occur and is defined as the share of initially uninfected people who become infected in a year.
3. UNAIDS defines a generalised epidemic as one in which adult HIV prevalence among the general adult population is at least 1 per cent and transmission is mostly heterosexual and a concentrated epidemic as one in which HIV is concentrated in groups with behaviours that expose them to a high risk of HIV infection. (See http://data.unaids.org/pub/GlobalReport/2006/2006_Epi_backgrounder_on_methodology_en.pdf).
4. Among other factors, the tissue of the internal foreskin contains large concentrations of “target cells” for HIV infection. See Bailey *et al.* (2001) and Auvert *et al.* (2005).
5. CD4 cells orchestrate the body’s immune response to viral and other infections.
6. In contrast, the epidemiological modelling of Oster (2005), as noted above, indicates that the differences in HIV prevalence between Sub-Saharan Africa and the United States is attributable primarily to differences in transmission rates of the virus (reflecting the very high rates of untreated ulcerative STIs in Africa), though sexual behaviour and epidemic timing do help explain differences within Africa. Thus her results argue against sexual mixing patterns as a significant source of the difference between Africa and elsewhere. These results, however, may be sensitive to the way in which sexual networks are incorporated into the model. See Kohler and HELLERINGER (2006).
7. It should be pointed out that with HIV/AIDS, any intervention that alters the level of infectiousness or risk behaviour of some individuals will have potentially significant externalities via sexual networks: the private decision of individuals to seek medical treatment, testing, purchase condoms, etc., will have benefits or costs to their partners by exposing them to reduced (or greater) risk of infection, and consequently to their partners’ partners, and so on (see Over, 1999). The example in the text in

contrast refers to effects of an intervention on the behaviour and attitudes of non-participants through the operation of social networks or other means.

8. Senegal also is notable for an aggressive and early policy stance against AIDS. Unlike Uganda and most of Africa, these actions were able to contain the disease before it reached generalised epidemic stage; HIV in Senegal still appears concentrated among specific high risk groups such as sex workers (UNAIDS, 2006).
9. The responses from the DHS indicate either that people in Uganda were more likely to recognise other's illness and mortality as being caused by AIDS, or that others or their families were more likely to admit to having AIDS, or both. Since AIDS victims do not die from the HIV virus itself but from a variety of other infections that take advantage of weakened immune systems, it is easy (and very common in Africa) for families to claim that death was from some cause other than AIDS.
10. Thus "ABC", in the sense of an equal emphasis on each element, is not a totally accurate characterisation of Uganda's early successful prevention campaign; indeed the phrase apparently came into use only later, in the mid 1990s (Slutkin *et al.*, 2006).
11. The distinction is important, as abstinence (and especially, abstinence-only) messages for young people have become much more prominent in Uganda in recent years, encouraged by social conservatives, the US government and First Lady Janet Museveni. For a discussion of the controversy see Epstein (2005).
12. The epidemic appears to have started somewhat earlier in Uganda than in neighbouring countries, fostered by years of civil war and dislocation that ended in 1986.
13. Although Allen and Heald (2004), as noted below, argue that policy makers in Botswana indeed pushed hard, but that the emphasis of policy – on condoms – was misdirected.
14. Condom use appears to be high within serodiscordant couples who have been tested (see below in the discussion of VCT), but with testing rates still low the vast majority of serodiscordant couples in Africa are not aware of their HIV status.
15. Moore and Hogg (2004), discussed further below, are able to control for many of these "other things" by looking at trends in HIV prevalence in areas in Western Kenya and Eastern Uganda along the border of the two countries. For these two geographically proximal areas, there are few important differences in factors such as ethnic groupings or male circumcision rates, so differences in prevalence trends are more likely to be due to the major differences in policy stance of the two countries. This comparison comes closer to the ideal of intervention and comparison group study design than comparing countries as a whole.
16. A related controversy is whether advising young people about condoms encourages earlier sexual activity. As noted, Dufflo *et al.* for Kenya found that condom education increased condom use by teenagers but not rates of sexual activity (both behaviors self-reported).

17. The survey by Bollinger *et al.* (2004), covering interventions in all developing countries published as of two years earlier, could not locate a single evaluation study of non-school based adolescent prevention programmes that used as outcome measures either self-reported condom use, number of partners or age at first sex.
18. However, as Glick (2005) notes with respect to this much cited study, even a rigorously conducted individualised randomised study may not provide meaningful estimates of programme efficacy. Individuals are randomly assigned to intervention and control groups only after recruitment into the study. Recruitment itself is not random but relies necessarily on volunteers and these individuals may be unrepresentative of the target population in terms of motivation or other factors influencing responsiveness to the intervention. The randomised trial does ensure stronger internal validity, meaning that it provides reliable estimates of the effect of VCT on those who volunteer, the “effect of treatment on the treated”. But external validity – the credibility of the findings as indicators of efficacy for the target population in general – may be weak.
19. It should be noted that this is conditional on having agreed in the first place to give a blood sample (78 per cent of respondents).
20. “Routine” means that an HIV test is given by default as part of any medical care, but the patient has the option of refusing the test; hence it is an “opt out” approach to testing as opposed to the “opt in” stance of VCT.
21. These and a number of other relevant studies were presented at a 2006 symposium titled “Linking Reproductive Health, Family Planning and HIV/AIDS in Africa”. See http://www.jhsph.edu/gatesinstitute/policy_practice/leadership_forums/fphivmtg/agenda.html.
22. De Walque (2006) is able to address this issue more directly using recent DHSs with HIV testing. He finds a non-trivial number of cases of serodiscordant couples in which the female rather than the male is the HIV positive partner, meaning that the woman contracted the infection outside the partnership. These cases are often at odds with self-reports about extramarital partners by the woman and it can be inferred that a significant share of them are not due to infections received prior to the current relationship. Thus his analysis points to at least some underreporting by women of the number of current or recent sexual partners.
23. It will be useful if randomisation is not perfect, as noted below. Even when the randomisation is valid there are several advantages to collecting baseline data, including greater statistical precision (see Duflo *et al.*, 2006).
24. As noted (see note 7), this would characterise any HIV prevention intervention, given impacts on others in the population via transmission of risk through sexual networks. Beyond this, however, some interventions will also have impacts on behaviours or attitudes of non-participants that are important to understand.
25. Clinical randomised trials of medical interventions related to fertility and reproductive health are more common, but as indicated, the focus here is on behavioural interventions or at least, on evaluations considering behavioural outcomes.

26. Although community-level experiments can assess some of them, such as modes of local involvement in mobilisation efforts. Obviously this cannot be said of factors such as “national leadership”.
27. The focus here is on behaviour change in the general population (i.e., not the knowingly HIV infected) in response to changes in actual or perceived HIV risk. The exception to this is the discussion of the effects of knowledge of own HIV status on fertility outcomes (effects of own HIV status on risk behaviours were discussed earlier.)
28. There is no reason to suppose that the effect of HIV prevalence is linear, as assumed in Oster’s (and others’) analysis; perhaps behavioural responses only emerge beyond some threshold level of (say) local death rates. Fitting a linear response will then underestimate behavioural response over the right-hand portion of the HIV prevalence distribution.
29. Although couched strictly in the terminology and assumptions of economic behaviour, Oster’s findings and hypothesis could be said to echo, in part, the cultural analysis of Caldwell (2000), who stresses the importance in Africa of attitudes toward death (including the pre-HIV possibility of early death) in explaining unwillingness to adjust behaviour to avoid HIV risk. The anthropologist’s notion of “fatalism” in this case may jibe with the rational recognition of the possibility of early death.
30. Of course, the strategy followed, not just the level of resources or commitment, is also likely to matter, as the comparative study of Botswana and Uganda (Allen and Heald, 2004) demonstrates.
31. Oster’s simulations of improving HIV risk knowledge suggest that even large improvements in knowledge will not lead to major changes in the mean levels of risk behaviour or in incidence.
32. See Epstein and Kim (2007), who argue that changing values has been a key means by which behaviour change has occurred in Uganda and elsewhere. They note in particular the role of Ugandan women’s groups in promoting the notion that it is reproachful for men to engage in relationships with multiple partners.
33. For several papers on this topic see the special supplement to Sexually Transmitted Infections, Volume 80, Supplement 2 (December 2004).
34. Even when the sampling frame is the same, sampling procedures in the field may lead to changes in sample composition (see Glick *et al.*, 2006, for an analysis of DHSs from Madagascar).
35. While this statement is strictly true, it must be recognised that not all of the difference in the control variables between two samples need be spurious, even for surveys spaced only several years apart. For example, average household wealth may have increased in the interval, and this could have led to actual changes in behaviour. With these factors held constant, however, the regression estimate of the survey effect (the ‘trend’) does not capture this source of change. Nevertheless, the estimated effect is still informative, as it shows how behaviour has changed over time

for individuals with a given set of characteristics, thus capturing policy effects or the effects of the epidemic on behaviour controlling for the effects, say, of economic growth.

36. As Gersovitz (2005) points out, however, the inconsistency could be caused by other factors such as age bias, whereby as the cohort gets older individuals are more willing to be frank about youthful behaviour, or alternatively, they become more conservative and hence less willing. Differential mortality of high and low risk individuals may also affect the comparison, although Gersovitz argues that this is not a major factor in his analysis of Kenya, Tanzania, Uganda and Zambia.
37. With regard to changes in question format, there is not much the researcher can do to assess whether this is leading to problems, although very large changes in responses would be a clue. The designers of DHSs, in particular, have generally attempted to keep formats as consistent as possible across years, even though in various countries there have been some changes in HIV/AIDS-related questions.
38. Without testing, the onset of severe symptoms such as weakness, weight loss and opportunistic infections will indicate to some that they have AIDS though even then there is likely to be uncertainty (Setel, 1995), and of course this typically occurs after some years of being HIV positive. Therefore most people with HIV who have not been tested do not know they are infected.
39. However, the instruments Kalem-Ozcan uses to predict HIV rates, STI incidence and shares of young women reporting premarital sex are certainly questionable. For the exclusion restriction to be met it must be assumed, implausibly, that these factors influence fertility only through their effects on HIV rather than directly.
40. Comprehensive longitudinal data collected in single areas (e.g., a district), such as those collected in Rakai and Masaka, have many advantages, but a disadvantage is that there may be little meaningful spatial differences in HIV prevalence/incidence or in changes in prevalence/incidence. If so, analysis must rely solely on intertemporal variation to discern relationships between behaviour and local HIV risk.
41. This may be the case for the “distance to the epicentre” instrument. Note that variables such as distances to towns or to transportation networks, while likely correlated with local HIV rates are not valid instruments. These factors also likely affect levels of risk behaviour directly by altering the nature of sexual networks.
42. Assuring representivity in these surveys remains a concern owing to selective non-response in testing, which shows substantial variation across countries (see Garcý’a-Calleja *et al.*, 2006). Even given these issues, these new population-based data have led to a significant downward revision in prevalence estimates in most countries compared with prior estimates obtained from antenatal surveillance sites, confirming long held concerns that the latter were not representative of the population at large.
43. This is the estimated survival time on “first-line” drug combinations, which eventually stop working. In developed countries individuals are expected to live longer than this on first-line therapies, and then are able to switch to second-line or even third-line approaches. These are much more expensive, and unlike the first-line

drugs, generics have not been developed for them. Hence it seems a long way off before they will be available to the poor in Africa.

44. Studies for Africa of the effects of AIDS illness or death on household incomes and expenditures (using varying methodologies) include Bachmann and Booysen (2003, 2004), Bechu (1998), Bollinger *et al.* (1999), Gregson, Mushati and Nyamukapa (2006), Menon *et al.* (1998), Ngalula *et al.* (2002), Over *et al.* (1996), and Steinberg *et al.* (2002).
45. The Food Security Group at Michigan State University maintains a website with links to many research papers on this topic (http://www.aec.msu.edu/fs2/adult_death/index.htm).
46. “Orphans” rather than “children orphaned by AIDS” since the cause of parental death is usually not known.
47. Although as Case *et al.* (2004) note, one should compare children of comparable ages (and possibly gender as well) to obtain meaningful estimates.
48. Note that adding controls for household characteristics in a regression framework does not overcome the problem of non-randomness of orphan status and leads to results that unlike the purely descriptive comparisons of mean outcomes are not interpretable. Consider the simple regression

$$Hi = \alpha_1 O_i + \alpha_2 X_i + \lambda_i + e_i,$$

where Hi is a human capital (health or schooling) indicator for child i , O_i is an indicator of orphan status, and X_i is a control for current (receiving) household income. $\{\lambda_i + e_i\}$ is a compound error term composed of unobserved (pre-parental illness) determinants of child human capital such as cumulative nutrition or prior school investments (represented by λ_i) and a random disturbance term (e_i). For the coefficient on O_i to represent the causal effect of orphanhood, orphan status would have to be uncorrelated with the error term, hence with all elements of λ_i . Note that one of these elements is originating household income, which is not observed. As discussed in the text, these assumptions are not plausible. Even without these problems, observed current household income X_i may be affected by the presence of an orphan (especially if resources are represented by per capita consumption); the effect of orphanhood as measured by α_1 would be net of this effect hence would not capture the total impact.

49. Despite this use of this term, note that this within household estimator is different from “household level fixed effects” described in the last section, whereby one differences household level outcomes and determinants across time.
50. The foregoing considers the situation of orphaned children being taken into new households. In other cases orphans remain in the same household but are deprived of the care and resources of their parent(s). The problem for the within-household estimators noted in the text – that the counterfactual of the orphan’s pre-mortality welfare is not represented by the current welfare of non-orphans in the same household – still applies under a range of assumptions about intrahousehold distribution. First, if resources are not completely pooled among household members

(in particular, if parents and their children form semi-autonomous units within the household), orphans and non-orphans in the same household would likely have differed even in the absence of parental death. If these differences are systematic because of differential AIDS mortality among adults, the non-orphans are not appropriate as a control group. Second, to the extent that resources are at least partially pooled among household members, the welfare of the non-orphan children will be affected by the death of any adult income earner or care provider in the household, so current measures for this group again are not representative of pre-death conditions, for either orphans or non-orphans.

51. The cumulative nature of health or schooling outcomes can, subject to certain assumptions, be captured by including prior (lagged) values of the outcomes in the regression explaining current outcomes. This yields a more appropriate specification, but it is well known that differencing this model does not remove bias from unobservables (see Strauss and Thomas, 1995). It could be estimated consistently using instrumental variable fixed effects, but this requires finding exogenous variables in the data that can predict prior schooling or health.
52. Case *et al.* (2004) argue, however, that Ainsworth and Filmer's comparisons of orphans and non-orphans are misleading because they fail to adjust for differences in mean age and sex across the two groups.
53. South Africa features the KwaZulu-Natal Income Dynamics Survey, the Cape Area Panel Study, the South African Labour Force Survey, and the Africa Centre Demographic Information System (ACDIS) KwaZulu Natal rural panel. Panel data from other African countries have been mentioned throughout this paper.

References

- Agha, Sohail. 2002. "Quasi-experimental study to assess the impact of four adolescent sexual health interventions in Sub-Saharan Africa". *International Family Planning Perspectives*, 28 (2): 67–70.
- Ahmed, Saifuddin, Tom Lutalo, Maria Wawer, David Serwadda, Nelson K. Sewankambo, Fred Nalugoda *et al.* 2001. "HIV incidence and sexually transmitted disease prevalence associated with condom use: A population study in Rakai, Uganda". *AIDS*, 15 (16): 2171–9.
- Ainsworth, Martha, Kathleen Beegle and Godlike Koda. 2005. "The impact of adult mortality and parental deaths on primary schooling in north-western Tanzania". *The Journal of Development Studies*, 41 (3): 413–5.
- Ainsworth, Martha and Deon Filmer. 2002. "Poverty, AIDS and children's schooling: A targeting dilemma". Policy Research Working Paper No. 2885, September. The World Bank, Washington, D.C.
- Aka-Dago-Akribi, H., A. Desgrees Du Lou, Philippe Msellati, R. Dossou and C. Welffens-Ekra. 1999. "Issues surrounding reproductive choice for women living with HIV in Abidjan, Côte d'Ivoire". *Reproductive Health Matters*, 7 (13): 20–9.

- Alderman, H., J. Behrman, H.-P. Kohler, and S. Watkins. 2001. "Attrition in longitudinal household survey data: Some tests for developing country samples". *Demographic Research*, 5 (4): 79–124.
- Allen, S., A. Serufilira, V. Gruber, S. Kegeles, P. Van de Perre, M. Carael and T.J. Coates. 1993. "Pregnancy and contraception use among urban Rwandan women after testing and counselling". *American Journal of Public Health*, 83: 705–10.
- Allen, Tim and Suzette Heald. 2004. "HIV/AIDS policy in Africa: What has worked in Uganda and what has failed in Botswana?" *Journal of International Development*, 16 (8): 1141–54.
- Arndt, Channing. 2006. "Review of 'The macroeconomics of HIV/AIDS'". *Journal of African Economies*. Available online at: doi:10.1093/jae/ejl024 <http://jae.oxfordjournals.org/cgi/content/abstract/ejl024v1>.
- Arndt, C. and J.D. Lewis. 2000. "The macro implications of HIV/AIDS in South Africa: A preliminary assessment". *South African Journal of Economics*, 68 (5): 380–4.
- Askew, Ian and Ndugga Baker Maggwa. 2002. "Integration of STI prevention and management with family planning and antenatal care in Sub-Saharan Africa – What more do we need to know?" *International Family Planning Perspectives*, 28 (2): 77–87.
- Auvert, Bertran, Dirk Taljaard, Emmanuel Lagarde, Joëlle Sobngwi-Tambekou, Rémi Sitta and Adrian Puren. 2005. "Randomised, controlled intervention trial of male circumcision for reduction of HIV infection risk: The ANRS 1265 trial". *PLoS Medicine*, 2 (11): 1112–22. e298 doi:10.1371/journal.pmed.0020298.
- Bachmann, Max O. and Frederick L.R. Booysen. 2003. "Health and economic impact of HIV/AIDS on South African households: A cohort study". *BMC Public Health*, 3: 14.
- Bachmann, Max O. and Frederick L.R. Booysen. 2004. "Relationships between HIV/AIDS, income and expenditure over time in deprived South African households". *AIDS Care*, 16 (7): 817–26.
- Bailey, Robert C., Francis A. Plummer and Stephen Moses. 2001. "Male circumcision and HIV. prevention: Current knowledge and future research directions". *Lancet Infectious Diseases*, 1 (4): 223–231.
- Barnett, T., J. Tumushabe, G.B. Bantebya, R. Ssebuliba, J. Ngasongwa, D. Kapinga *et al.* 1995. "The social and economic impact of HIV/AIDS on farming systems and livelihoods in rural Africa: Some experience and lessons from Uganda, Tanzania, and Zambia". *Journal of International Development*, 7 (1): 163–76.
- Batter, V., B. Matela, M. Nsuami, T. Manzila, M. Kamenga, F. Behets, R.W. Ryder, W.L. Heyward, J.M. Karon, and M.E. St Louis. 1994. "High HIV-1 incidence in young women masked by stable overall seroprevalence among childbearing women in Kinshasa, Zaire: Estimating incidence from serial seroprevalence data". *AIDS*, 8: 811–7.
- Bechu, N. 1998. "The impact of AIDS on the economy of families in Côte d'Ivoire: Changes in consumption among AIDS-affected households". In M. Ainsworth, L. Fransen and M. Over, eds., *Confronting AIDS: Evidence from the Developing*

- World: Selected Background Papers for the World Bank Policy Research Report. Brussels: European Commission.
- Beegle, K. 2003. "Labour effects of adult mortality in Tanzanian households". Policy Research Working Paper No. 3062. The World Bank, Washington, D.C.
- Beegle, K., J. De Weerd and S. Dercon. 2005. "Orphanhood and the long-run impact on children". Mimeo. World Bank, Economic Development Institute and Oxford University.
- Beegle, Kathleen, Joachim De Weerd and Stefan Dercon. 2008. "Adult mortality and consumption growth in the age of HIV/AIDS". *Economic Development and Cultural Change*, 56: 299–326.
- Bell, C., S. Devarajan and H. Gersbach. 2003. "The long-run economic costs of AIDS: Theory and an application to South Africa". *World Bank Economic Review*, 20 (1): 55–89.
- Bell, C., S. Devarajan and H. Gersbach. 2004. "Thinking about the long-run economic costs of AIDS". In M. Haaker, ed., *The Macroeconomics of HIV/AIDS*. Washington, D.C.: International Monetary Fund.
- Bessinger R., P. Akwara and D. Halperin. 2003. "Sexual behaviour, HIV and fertility trends: A comparative analysis of six countries". Phase I of the ABC Study, University of North Carolina, MEASURE Evaluation Project.
- Bicego, George, Shea Rutstein and Kiersten Johnson. 2003. "Dimensions of the emerging orphan crisis in Sub-Saharan Africa". *Social Science and Medicine*, 56 (6): 1235–47.
- Bloom, Davie E. and Ajay S. Mahal. 1997. "Does the AIDS epidemic threaten economic growth?" *Journal of Econometrics*, 77 (1): 105–24.
- Bollinger, Lori, Katharine Cooper-Arnold and John Stover. 2004. "Where are the gaps? The effects of HIV-prevention interventions on behavioral change". *Studies in Family Planning*, 35 (1): 27–38.
- Bollinger, Lori, John Stover, R. Kerkhoven, G. Mutangadura and D. Mukurazita. 1999. *The Economic Impact of AIDS in Zimbabwe*. Washington, D.C.: Futures Group/Research Triangle Institute/Center for Development and Population Activities.
- Breirova, Lucia. 2002. "AIDS and schooling in Kenya". Unpublished working paper. Massachusetts Institute of Technology (MIT), Cambridge, Massachusetts.
- Caldwell, John C. 2000. "Rethinking the African AIDS epidemic". *Population and Development Review*, 26 (1): 117–35.
- Caldwell, John C. and Pat C. Caldwell. 2002. "Is integration the answer for Africa?" *International Family Planning Perspectives*, 28 (2): 108–10.
- Carpenter L.M., J.S. Nikiyingi, A. Ruberantwari, S. Malamba, A. Kamali and J.A.G. Whitworth. 1997. "Estimates of the impacts of HIV-1 infection on fertility in a rural Ugandan cohort". *Health Transition Review*, 7 (Supplement): 113–26.
- Case, Anne and Cally Ardington. 2005. "The impact of paternal death on school enrollment and achievement: Longitudinal evidence from South Africa". Paper presented at the

- International Union of the Scientific Study of Population seminar on Interactions between Poverty and HIV/AIDS, Cape Town, South Africa, December.
- Case, Anne, Christina Paxson and Joseph Ableidinger. 2004. "Orphans in Africa: Parental death, poverty, and school enrollment." *Demography*, 41 (3): 483–508.
- Cassell, Michael M., Daniel T. Halperin, James D. Shelton and David Stanton. 2006. "Risk compensation: The Achilles' heel of innovations in HIV prevention?" *BMJ*, 332: 605–7.
- Chatterji, Minki, Leanne Dougherty, Tom Ventimiglia, Yvonne Mulenga, Andrew Jones, Antoinette_Mukaneza, Nancy Murray, Kathy Buek, William Winfrey and Joseph Amon. 2005. *The Well-Being of Children Affected by HIV/AIDS in Gitarama Province, Rwanda, and Lusaka, Zambia: Findings from a Study*. Community REACH Working Paper No. 2. Washington, D.C.: Community REACH Program, Pact.
- Cheluget, B., G. Baltazar, P. Orege, M. Ibrahim, L.H. Marum and J. Stover. 2006. "Evidence for population level declines in adult HIV prevalence in Kenya". *Sexually Transmitted Infections* 82 (suppl 1): i21–i26; doi:10.1136/sti.2005.015990.
- Cleland, John and Mohamed M. Ali. 2006. "Sexual abstinence, contraception, and condom use by young African women: A secondary analysis of survey data". *The Lancet*, 368: 1788–93.
- Cohen, Myron, Irving Hofman, Rachel Royce, Peter Kazembe, John Dyer, Celine Daly *et al.* 1997. "Reduction of concentration of HIV-1 in semen after treatment of urethritis: Implications for prevention of sexual transmission of HIV-1". *The Lancet*, 349: 1868–73.
- Cutler, David. 2002 "Behavioral health interventions: What works and why?" Working paper, Department of Economics, Harvard University.
- Dare, O.O. and J.G. Cleland. 1994. "Reliability and validity of survey data on sexual behaviour". *Health Transition Review*, 4 (suppl): 93–110.
- Deininger, Klaus, Anja Crommelynck and Gloria Kempaka. 2005. "Impact of AIDS on family composition, welfare and investment: Evidence from Uganda". *Review of Development Economics*, 9 (3): 303–24.
- De Walque, Damien. 2004. "How does the impact of an HIV/AIDS information campaign vary with educational attainment? Evidence from rural Uganda". Policy Research Working Paper No. WPS 3289. Development Research Group, The World Bank, Washington, D.C.
- De Walque, Damien. 2006. "Discordant couples: HIV infection among couples in Burkina Faso, Cameroon, Ghana, Kenya, and Tanzania". Policy Research Working Paper No. 3956. The World Bank, Washington, D.C.
- DFID. 2004. "DFID knowledge programme on HIV/AIDS and STIs". *MEMA kwa Vijana: Community Randomised Trial of an Adolescent Sexual Health Programme in Rural Mwanza, Tanzania*. Department for International Development, London, UK.
- Dixon, Simon, Scott McDonald and Jennifer Roberts. 2001. "AIDS and economic growth in Africa: A panel data analysis". *Journal of International Development*, 13: 411–26.

- Donovan, D., L. Bailey, E. Mpyisi, and M. Weber. 2003. "Prime-age adult morbidity and mortality in rural Rwanda: Effects on household income, agricultural production, and food security strategies". Research report. <http://www.aec.msu.edu/agecon/fs2/rwanda/index.html>.
- Dreyfuss, M.L., G.I. Msamanga, D. Spiegelman, Esther Duflo, Pascaline Dupas, Michael Kremer and Samuel Sinei. 2006. "Education and HIV/AIDS prevention: Evidence from a randomised evaluation in Western Kenya". Policy Research Working Paper No. 4024. The World Bank, Washington, D.C.
- Duflo, E. R. Glennerster and M. Kremer. 2006. "Using randomisation in development economics: A toolkit". NBER Technical Working Paper 0333. National Bureau of Economic Research, Cambridge, Massachusetts.
- Dupas, Pascaline. 2006. "Relative risks and the market for sex: Teenagers, sugar daddies and HIV in Kenya". Draft. Dartmouth College.
- Epstein, Helen. 2005. "God and the fight against AIDS. How faith-based AIDS work is changing the fight in Uganda". *The New York Review of Books*, Vol. 52, No. 7, 28 April 2005.
- Epstein, H, and J. Kim. 2007 "AIDS and the power of women". *New York Review of Books*, Vol. 54, No. 2, 15 February 2007.
- Evans, David. 2005. "The spillover impacts of Africa's orphan crisis". Unpublished manuscript. Harvard University.
- Evans, David and Edward Miguel. 2004. "Orphans and schooling in Africa: A longitudinal analysis". Unpublished manuscript. Harvard University and University of California, Berkeley.
- Fenton, Lynda. 2004. "Preventing HIV/AIDS through poverty reduction: The only sustainable solution?" *The Lancet*, 364: 1186–7.
- Ferradini, Laurent, Arnaud Jeannin, Loretxu Pinoges, Jacques Izopet, Didakus Odhiambo, Limangeni Mankhambo *et al.* 2006. "Scaling up of highly active antiretroviral therapy in a rural district of Malawi: An effectiveness assessment". *The Lancet*, 367 (9519): 1335–42.
- Foreit J. 2001. *Improving Reproductive Health by Involving Men in Community-Based Distribution*. Programme Briefs, 2001, No. 2. Population Council/FRONTIERS, Washington, D.C.
- Foreit, Karen, G. Fleischman, Karen Hardee and Kokila Agarwal. 2002. "When does it make sense to consider integrating STI And HIV services with family planning services". *International Family Planning Perspectives*, 28 (2): 105–07.
- Fylkesnes, Knut and Seter Siziya. 2004. "A randomised trial on acceptability of voluntary HIV counselling and testing". *Tropical Medicine & International Health*, 9 (5): 566–72.
- Fylkesnes, Knut, Rosemary Musonda, Moses Sichone, Zacchaeus Ndhlovu, Francis Tembo, Mwaka Monze. 2001. "Declining HIV prevalence and risk behaviours in Zambia: Evidence from surveillance and population-based surveys". *AIDS*, 15 (7): 907–16.

- Gallant, Melanie and Eleanor Maticka-Tyndale. 2004. "School-based HIV prevention programmes for African youth". *Social Science and Medicine*, 58 (7): 1337–51.
- García-Calleja, J.M., E. Gouws and P.D. Ghys. 2006. "National population based HIV prevalence surveys in sub-Saharan Africa: Results and implications for HIV and AIDS estimates". *Sexually Transmitted Infections*, 82 (Suppl III): iii64–iii70.
- Garenne, M.L., and F. Vincent. 2006. "Potential and limits of verbal autopsies". *Bulletin of the World Health Organisation*, 84 (3): 164–5.
- Garnett, G.P., J.M. Garcia-Calleja, T. Rehle and S. Gregson. 2006. "Behavioural data as an adjunct to HIV surveillance data". *Sexually Transmitted Infections*, 82: i57–i62.
- Gersovitz, Mark. 2005. "The HIV epidemic in four African countries seen through the Demographic and Health Surveys". *Journal of African Economies*, 14 (2): 191–246.
- Gersovitz, Mark, Hanan Jacoby, F. Seri Dedy and A. Goze Tape. 1998. "The balance of self-reported heterosexual activity in KAP surveys and the AIDS epidemic in Africa". *Journal of the American Statistical Association*, 93 (443): 875–83.
- Gillespie, Stuart and Suneetha Kadiyala. 2005. "HIV/AIDS and food and nutrition security from evidence to action". *Food Policy Review 7*. International Food Policy Research Institute, Washington, D.C. <http://www.ifpri.org/pubs/fpreview/pv07/pv07.pdf>.
- Glick, Peter. 2005. "Scaling up HIV voluntary counseling and testing in Africa. What can evaluation studies tell us about potential prevention impacts?" *Evaluation Review*, 29 (4): 331–57.
- Glick, Peter and David E. Sahn. 2007. "Changes in HIV/AIDS knowledge and testing behavior in Africa: How much and for whom?" *Journal of Population Economics*, in press.
- Glick, Peter and David E. Sahn. 2008. "Are Africans practicing safer sex: Evidence from Demographic and Health Surveys for eight countries". *Economic Development and Cultural Change*, 56 (2): 397–439.
- Glick, Peter, David E. Sahn and Stephen D. Younger. 2006. "An assessment of changes in infant and under-five mortality in Demographic and Health Survey data for Madagascar". Cornell Food and Nutrition Policy Program Working Paper No. 207. Cornell University, Ithaca, New York.
- Goldstein, Markus, Joshua Graff Zivin and Harsha Thirumurthy. 2006. "AIDS treatment and intrahousehold resource allocations: Children's nutrition and schooling in Kenya". Draft. Yale University, New Haven, Connecticut.
- Goldstein, Markus, Joshua Graff Zivin, Mabel Nangami and Harsha Thirumurthy. 2005. "HIV/AIDS and socio-economic status: Preliminary evidence from Western Kenya". Mimeo. Yale University, New Haven, Connecticut.
- Gray, Ronald H., Maria J. Wawer, David Serwadda, Nelson Sewankambo, Chuanjun Li, Frederick Wabwire-Mangen *et al.* 1998. "Population-based study of fertility in women with HIV-1 in Uganda". *The Lancet*, 351 (9096): 98–103.

- Gray, Ronald H., Xianbin Li, Godfrey Kigozi, David Serwadda, Heena Brahmabhatt, Fred Wabwire-Mangen *et al.* 2005. "Increased risk of incident HIV during pregnancy in Rakai, Uganda: A prospective study". *The Lancet*, 366 (9492): 1182–8.
- Green, E., V. Nantulya, R. Stoneburner and J. Stover. 2002. "What happened in Uganda? Declining HIV prevalence, behavior change, and the national response", Washington, D.C.: USAID. <http://www.synergyaids.com/Documents/WhatHappenedUganda.pdf>
- Green, E.C., D.T. Halperin, V. Nantulya and J. Hogle. 2006. "Uganda's HIV prevention success: The role of sexual behavior change and the national response". *AIDS and Behaviour*, 10 (July): 335–46.
- Gregson, S. 1994. "Will HIV become a major determinant of fertility in Sub-Saharan Africa?" *Journal of Development Studies*, 30 (3): 650–79.
- Gregson, Simon, Phyllis Mushati and Constance Nyamukapa. 2006. "Adult mortality and erosion of household viability in AIDS-afflicted towns, estates, and villages in Eastern Zimbabwe". *J Acquir Immune Defic Syndr*, 44 (2): 188–95.
- Gregson, Simon, Geoffrey P. Garnett, Constance A. Nyamukapa, Timothy B. Hallett, James J.C. Lewis, Peter R. Mason *et al.* 2006. "HIV decline associated with behavior change in Eastern Zimbabwe". *Science*, 311: 664–6.
- Gregson, S., T. Zhuwau, R.M. Anderson and S.K. Chandiwana. 1997. "HIV and fertility in rural Zimbabwe". *Health Transition Review*, 7 (Suppl. 2): 89–112.
- Grosskurth, F.H., J. Todd, E. Mwijarubi, P. Mayaud, A. Nicoll, G. ka-Gina *et al.* 1995. "Impact of improved treatment of sexually transmitted diseases on HIV infection in rural Tanzania: Randomised controlled trial". *The Lancet*, 346 (8974): 530–6.
- Guay, Laura A., Philippa Musoke, Thomas Fleming, Danstan Bagenda, Melissa Allen, Clemensia Nakabiito *et al.* 1999. "Intrapartum and neonatal single-dose nevirapine compared with zidovudine for prevention of mother-to-child transmission of HIV-1 in Kampala, Uganda: HIVNET 012 randomised trial". *The Lancet*, 354 (9181): 795–802.
- Haaker, M. ed. 2004. *The Macroeconomics of AIDS*. Washington, D.C.: International Monetary Fund.
- Hallett, T.B., J. Aberle-Grasse, G. Bello, L-M. Boulos, M.P.A. Cayemittes, B. Cheluget *et al.* 2006. "Declines in HIV prevalence can be associated with changing sexual behaviour in Uganda, urban Kenya, Zimbabwe, and urban Haiti". *Sexually Transmitted Infections*, 82 (Suppl 1): i1–8.
- Halperin, Daniel T. and Helen Epstein. 2004. "Concurrent sexual partnerships help to explain Africa's high HIV prevalence: Implications for prevention". *The Lancet*, 364 (9428): 4–6.
- Hearst, N., and S. Chen. 2004. "Condom promotion for AIDS prevention in the developing world: Is it working?" *Studies in Family Planning*, 35 (March): 39–47.

- Heyward, W., V. Makizayi, V.L. Batter, M. Malulu, N. Mbuyi, L. Mbu, M.F. St. Louis, M. Kamenga, and R.W. Ryder. 1993. "Impact of HIV counseling and testing among childbearing women in Kinshasa, Zaire". *AIDS*, 7: 1633–7.
- Holbrooke, Richard and R. Furman. 2004. "A global battle's missing weapon". *New York Times*, 10 February 2004.
- Homan, Rick, Saiqa Mullick, Mzikazi Nduna and Doctor Khoza. 2006. "Cost of introducing two different models of integrating VCT for HIV within family planning clinics in South Africa". Paper presented at the conference *Linking Reproductive Health, Family Planning and HIV/AIDS in Africa*, Addis Ababa, Ethiopia, 9-10 October. See http://www.jhsph.edu/gates/images/PDFFiles/HIV-FP-Presentations/Session%205A/Homan_SA%20VCT%20Integration.pdf.
- Hosegood, Victoria, Nuala McGrath, Kobus Herbst and Ian M. Timæus. 2004. "The impact of adult mortality on household dissolution and migration in rural South Africa". *AIDS*, 18 (11): 1585–90.
- Hunter, Susan-Catherine, Raphael Isingo, J. Ties Boerma, Mark Urassa, Gabriel M.P. Mwaluko and Basia Zaba. 2003. "The association between HIV and fertility in a cohort study in rural Tanzania". *Journal of Biosocial Science*, 35 (2): 189–99.
- Husain, I. and Peter Badcock-Walters. 2002. "Economics of HIV/AIDS impact mitigation: Responding to problems of systemic dysfunction and sectoral capacity". In S. Forsythe, ed., *State of the Art: AIDS and Economics*. International AIDS-Economic Network (IAEN). <http://www.policyproject.com/pubs/other/SOTAEcon.pdf>.
- Kagimu, M., E. Marum, F. Wabwire-Mangen, N. Nakyanjo, Y. Walakira, J. Hogle. 1998. "Evaluation of the effectiveness of AIDS health education interventions in the Muslim community in Uganda". *AIDS Educ Prev*. 10 (3): 215–28.
- Kajubi, P., M.R. Kamya, S. Kamya, S. Chen, W. McFarland, N. Hearst. 2005. "Increasing condom use without reducing HIV risk: Results of a controlled community trial in Uganda". *J Acquir Immune Defic Syndr*, 40 (1): 77–82.
- Kalemli-Ozcan, Sebnem. 2006. "AIDS, reversal of the demographic transition and economic development: Evidence from Africa". Working paper. University of Houston, Houston, Texas, USA.
- Kapiga, Saidi and Iain Aitken. 2003. *Role of Sexually Transmitted Diseases in HIV-1 Transmission*. New York: Kluwer Academic Publisher.
- Kamali, A., M. Quigley and J. Nakiyingi *et al.* 2003. "A community randomised trial of sexual behaviour and syndromic STI management interventions on HIV-1 transmission in rural Uganda". *The Lancet*, 361: 645–52.
- Kamali, A., H.U. Wagner, J. Nakiyingi, I. Sabiiti, J.F. Kengeya-Kayondo and D.W. Mulder. 1996. "Verbal autopsy as a tool for diagnosing HIV-related adult deaths in rural Uganda". *International Journal of Epidemiology*, 25 (3): 679–84.
- Kinsman, J., J. Nakiyingi, A. Kamali, L. Carpenter, M. Quigley, R. Pool and J. Whitworth. 2001. "Evaluation of a comprehensive school-based AIDS education programme in rural Masaka, Uganda". *Health Education Research*, 16 (1): 85–100.

- Kirby, D. 2001. *Emerging Answers: Research Findings on Programs to Reduce Teen Pregnancy*. Washington, D.C.: National Campaign to Prevent Teen Pregnancy.
- Kohler, Hans-Peter and Stéphane HELLERINGER. 2006. "The structure of sexual networks and the spread of HIV in Sub-Saharan Africa: Evidence from Likoma Island (Malawi)". Population Aging Research Center Working Paper No. WPS 06-02. University of Pennsylvania, Philadelphia, USA.
- Korenromp, E.L., R.G. White, K.K. Orroth, R. Bakker Maggwa, A. Kamali, D. Serwadda *et al.* 2005. "Determinants of the impact of sexually transmitted infection treatment on prevention of HIV infection: A synthesis of evidence from the Mwanza, Rakai, and Masaka intervention trials". *J Infect Dis*, 191 (suppl 1): S168–S178.
- Larivee, C. 2002. "FHI/Impact data for development of BCC programming". http://www.synergyaids.com/Documents/5_Carol_Larivee.pdf. Accessed 29 October 2002.
- Leroy, Valeriane, Philippe Van de Perre, Philippe Lepage, Joseph Saba, Francois Nsengumuremyi, Arlette Simonon *et al.* 1994. "Seroincidence of HIV-1 infection in African women of reproductive age: A prospective cohort study in Kigali, Rwanda, 1988–1992". *AIDS*, 8: 983–6.
- Ksoll, Christopher. 2006 "Family networks and orphan caretaking in Tanzania". Draft. Yale University. <http://www.econ.yale.edu/%7Ecjk29/KsollOrphansTanzania.pdf>.
- Lindblade, Kim, Frank Odhiambo, Daniel Rosen and Kevin DeCock. 2003. "Health and nutritional status of orphans <6 years old cared for by relatives in Western Kenya". *Tropical Medicine and International Health*, 8 (1): 67–72.
- Lloyd, Cynthia B. and Ann K. Blanc. 1996. "Children's schooling in Sub-Saharan Africa: The role of fathers, mothers, and others". *Population and Development Review*, 22 (2): 265–98.
- Luck, Margaret, Ebrima Jarju, M. Diane Nell and Melville O. George. 2000. "Mobilising demand for contraception in rural Gambia". *Studies in Family Planning*, 31 (4): 325–35.
- Lutalo, T., M. Kidugavu, and M. Wawer. 2000. "Contraceptive use and HIV counseling and testing in rural Rakai district, SW Uganda". Abstract C246. Paper presented at the 13th International Conference on HIV/AIDS, Durban, South Africa.
- Lutalo, Tom, Zikulah Namukwaya, Edward Kimera, David Serwadda, Maria Wawer and Ron Gray. 2006. "A community randomised trial of enhanced family planning effort in a Ugandan HIV surveillance program". Paper presented at the conference on Linking Reproductive Health, Family Planning and HIV/AIDS in Africa, Addis Ababa, Ethiopia, 9–10 October. http://www.jhsph.edu/gates/images/PDFFiles/HIV-FP-Presentations/Session%205/Lutalo_A%20community%20randomised%20trial%20of%20enhanced%20family%20planning.pdf.
- Manski, Charles. 1995. *Identification Problems in the Social Sciences*. Cambridge, Massachusetts: Harvard University Press.
- Marins, Jose Ricardo P. *et al.* 2003. "Dramatic improvement in survival among adult Brazilian AIDS patients". *AIDS*, 17: 1675–82.

- Martin, P.M.V., G. Gresenguet, V.M. Herve, G. Renom, G. Steenman and A.J. Georges. 1991. "Decreased number of spermatozoa in HIV infected individuals". *AIDS*, 6 (1): 130–1.
- Marum, Elizabeth, Miriam Taegtmeier and Kenneth Chebet. 2006. "Scale-up of voluntary HIV counseling and testing in Kenya". *JAMA*, 296: 859–62.
- Mather, D., C. Donovan, M. Weber, H. Marrule and A. Alage. 2004. "Prime age adult mortality and household livelihood in rural Mozambique: Preliminary results and implications for HIV/AIDS mitigation efforts". Paper prepared for the Annual Conference of the Centre for the Study of African Economies, Oxford, March. <http://www.csae.ox.ac.uk/conferences/2004-GPRaHDiA/papers/4r-MatherEtAl-CSAE2004.pdf>.
- Mather, D., C. Donovan, T.S. Jayne, M. Weber, E. Mazhangara, L. Bailey, K. Yoo, T. Yamano, and E. Mghenyi. 2004. "A cross-country analysis of household responses to adult mortality in rural Sub-Saharan Africa: Implications for HIV/AIDS mitigation and rural development policies". MSU International Development. Working Paper No. 82. Ann Arbor, Mich., U.S.A.: Michigan State University.
- Matovu, J.K.B., G. Kigozi, F. Nalugoda, F. Wabwire-Mangen and R.H. Gray. 2002. "The Rakai Project counselling programme experience". *Tropical Medicine & International Health*, 7 (12): 1064–7.
- Menon, R., M.J. Wawer, J.K. Konde-Lule, N.K. Sewankambo and C. Li. 1998. "The economic impact of adult mortality on households in Rakai district, Uganda". In M. Ainsworth, L. Fransen and M. Over, eds., *Confronting AIDS: Evidence from the Developing World: Selected Background Papers for the World Bank Policy Research Report*. Brussels: European Commission.
- Merson, M.H., J.M. Dayton and K. O'Reilly. 2000. "Effectiveness of HIV prevention interventions in developing countries". *AIDS*, 14 (2, supplement): 68–84.
- Michelo, C., I.F. Sandoy and K. Fylkesnes. 2006 "Marked HIV prevalence declines in higher educated young people: Evidence from population-based surveys (1995–2003) in Zambia". *AIDS*, 20 (7): 1031–8.
- Mishra, V. 2006. "Understanding the positive association between household wealth status and HIV prevalence in Sub-Saharan Africa". Paper presented at the International AIDS Economic Network Meeting, Toronto, August 2006.
- Moatti, J.P., I. N'Doye, S.M. Hammer, P. Hale and M.D. Kazatchkine. 2002. "Antiretroviral treatment for HIV-infected adults and children in developing countries: Some evidence in favor of expanded diffusion". In S. Forsythe, ed., *State of the Art: AIDS and Economics*. International AIDS-Economics Network (IAEN). <http://www.policyproject.com/pubs/other/SOTAEcon.pdf>.
- Monasch, Roeland and J. Ties Boerma. 2004. "Orphanhood and childcare patterns in Sub-Saharan Africa: An analysis of national surveys from 40 countries". *AIDS*, 18 (suppliment 2): S55–S65.
- Moore, D.M. and R.S. Hogg. 2004. "Trends in antenatal human immunodeficiency virus prevalence in Western Kenya and Eastern Uganda: Evidence of differences in health policies?" *International Journal of Epidemiology*, 33 (3): 542–8.

- Morris, M. and M. Kretzschmar. 1997. "Concurrent partnerships and the spread of HIV". *AIDS*, 11: 681–3.
- Mphuru, Lucy, Mark Barone, Paul Perchal and Grace Lusiola. 2006. "Integration of voluntary counseling and testing for HIV into family planning and reproductive and child health services in Tanzania". Paper presented at the conference Linking Reproductive Health, Family Planning and HIV/AIDS in Africa, Addis Ababa, Ethiopia, 9–10 October. http://www.jhsph.edu/gates/images/PDFFiles/HIV-FP-Presentations/Session%203B/Mphuru_addis.pdf.
- Mushati, P., S. Gregson, M. Mlilo, J. Lewis and C. Zvidzai. 2003. "Adult mortality and the economic sustainability of households in towns, estates, and villages in AIDS-affected Eastern Zimbabwe". Paper presented at the Scientific Meeting on Empirical Evidence for the Demographic and Socio-Economic Impact of AIDS, University of Durban, Durban, South Africa, March 2003.
- Myer, Landon, Catherine Mathews, Francesca Little and Salim S. Abdool Karim. 2001. "The fate of free male condoms distributed to the public in South Africa". *AIDS*, 15 (6): 789–93.
- Ngalula, J., M. Urassa, G. Mwaluko, R. Isingo and J. Ties Boerma. 2002. "Health service use and household expenditure during terminal illness due to AIDS in rural Tanzania". *Trop Med Int Health*, 7 (10): 873–7.
- Noël-Miller, C.M. 2003. "Concern regarding the HIV/AIDS epidemic and individual childbearing: Evidence from rural Malawi". *Demographic Research*, Special Collection 1, Article 10 -<http://www.demographic-research.org/special/1/10/>.
- Ntozi, James Patrick and Christine Tashobyo Kirunga. 1998. "Family planning and HIV/AIDS in Sub-Saharan Africa: Challenges and strategies". *African Journal of Reproductive Health*, 2 (2): 44–56.
- Nyblade, L., R. Gray, F. Makumbi, T. Lutalo, J. Menken, M. Wawer *et al.* 2000. "HIV risk characteristics and participation in voluntary counseling and testing in rural Rakai district, Uganda". Paper presented at the 13th International Conference on HIV/AIDS, Durban, South Africa (WeOrD63).
- Oster, E. 2005. "Sexually transmitted infections, sexual behavior, and the HIV/AIDS epidemic". *The Quarterly Journal of Economics*, 120 (2): 467–515.
- Oster, Emily. 2006. "HIV and sexual behavior change: Why not Africa?" Working Paper, University of Chicago. <http://ihome.ust.hk/~fnjuwong/paper/hivbehavior.pdf>.
- Over, Mead. 1999. "The public interest in a private disease". In King K. Holmes, P. Frederick Sparling, Per-Anders Mårdh, Stanley M Lemon, Walter E. Stamm, Peter Piot and Judith N. Wasserheit, eds., *Sexually Transmitted Diseases*. New York: McGraw-Hill.
- Over, Mead, Martha Ainsworth *et al.* 1996. "Coping with AIDS: The economic impact of adult mortality from AIDS and other causes on households in Kagera, Tanzania". The World Bank, Washington, D.C.
- Perchal, Paul, Lynn Collins, Beyeberu Assefa and Oksana Babenko. 2006. "Cost-effectiveness of integrating HIV prevention in maternal health programmes in Ethiopia and the Ukraine". Paper presented at the conference Linking Reproductive

- Health, Family Planning and HIV/AIDS in Africa, Addis Ababa, Ethiopia, 9–10 October. See http://www.jhsph.edu/gates/images/PDFFiles/HIV-FP-Presentations/Session%205A/Perchal_Cost-effectiveness%20of%20HIV%20prevention-Addis%20Conference-Oct-06.pdf.
- Phillips, J.F., A.A. Bawah and F.N. Binka. 2005. "The design, impact and utilisation of the Navrongo experiment in Ghana". Working Paper No. 208. Policy Research Division, Population Council, New York.
- Pop-Eleches, Christian. 2006. "The impact of a change in abortion regime on socio-economic outcomes of children: Evidence from Romania". *Journal of Political Economy*, 114: 744–73.
- Reynolds, Heidi, Jennifer Liku, Ndugga Maggwa, Maureen Kuyoh, Margaret Gitau, Marsden Solomon *et al.* 2006. "Integrating family planning services into voluntary counseling and testing for HIV in Kenya: Results of operations research". Paper presented at the conference Linking Reproductive Health, Family Planning and HIV/AIDS in Africa, Addis Ababa, Ethiopia, 9–10 October. See <http://www.jhsph.edu/gatesinstitute/CR/FP-HIV-Presentations>.
- Rosenzweig, Mark R. and Kenneth I. Wolpin. 2000. "Natural 'natural experiments' in economics". *Journal of Economic Literature*, 38: 827–74.
- Rutenberg, Naomi, Ann E. Biddlecom and Frederick A.D. Kaona. 2000. "Reproductive decision-making in the context of HIV and AIDS: A qualitative study in Ndola, Zambia". *International Family Planning Perspectives*, 26 (3): 124–30.
- Ryder, R.W., V.L. Batter, L. Mundeke, N. Badi, B. Matela, M. Utshudi *et al.* 1991. "Fertility rates in 238 HIV-1-seropositive women in Zaire followed for 3 years post-partum". *AIDS*, 5 (12): 1521–7.
- Setel, P. 1995. "The effects of HIV and AIDS on fertility in east and central Africa". *Health Transition Review*, 5 (Supplement): 179–90.
- Severe, Patrice, Paul Leger, Charles Macarthur, Francine Noel, Gerry Bonhomme, Gyrlande Bois *et al.* 2005. "Antiretroviral therapy in a thousand patients with AIDS in Haiti". *New England Journal of Medicine*, 353 (22): 2325–34.
- Sewankambo, N.K., M.J. Wawer, R.H. Gray, D. Serwadda, C. Li, R.Y. Stallings *et al.* 1994. "Demographic impact of HIV infection in rural Rakai District, Uganda: Results of a population-based cohort study". *AIDS*, 8 (12): 1707–13.
- Shah, M.K., N. Osborne, M. Mbilizi and G. Vilili. 2001. *Impact of HIV/AIDS on Agriculture Productivity and Rural Livelihoods in the Central Region of Malawi*. Lilongwe, Malawi: Care International in Malawi.
- Shelton, James D., Michael Cassell and Jacob Adetunji. 2005. "Is poverty or wealth at the root of HIV". *The Lancet*, 366 (9491): 1057–8.
- Singh, S., J.E. Darroch and A. Bankole. 2003. *ABC in Uganda: The Role of Abstinence, Monogamy and Condom Use in HIV Decline*. Occasional Report No. 9. The Allan Guttmacher Institute, New York.

- Slutkin, Gary, Sam Okware, Warren Naamara, Don Sutherland, Donna Flanagan, Michel Carael *et al.* 2006. "How Uganda reversed its HIV epidemic". *AIDS and Behavior*, 10 (4): 351–60.
- Steinberg, Malcolm, Saul Johnson, Gill Schierhout, David Ndegwa *et al.* 2002. *Hitting Home: How Households Cope with the Impact of the HIV/AIDS Epidemic*. The Henry J Kaiser Foundation, Washington, D.C.
- Stillwagon, Eileen. 2002. "HIV/AIDS in Africa: Fertile terrain". *Journal of Development Studies*, 38 (6): 1–22.
- Stoneburner, R. and D. Low-Beer. 2004. "Population-level HIV declines and behavioral risk avoidance in Uganda". *Science*, 304 (5671): 714–8.
- Strauss, J. and D. Thomas. 1995. "Human resources: Empirical modelling of household and family decisions". In T.N. Srinivasan and J. Behrman, eds., *Handbook of Development Economics*, Vol. 3. Amsterdam: North-Holland Publishing Company.
- Strauss, J. and D. Thomas. 2008. "Health over the life course". In T.P. Schultz and J. Strauss, eds., *Handbook of Development Economics*, Vol. 4. Amsterdam: North-Holland Publishing Company.
- Strecker, W., L. Gurtler, M. Binibangili and K. Strecker. 1993. "Clinical manifestations of HIV infection in Northern Zaire". *AIDS*, 7 (4): 597–8.
- Taha, E., Gina A. Dallabetta, Donald R. Hoover, John D. Chipangwi, Laban A.R. Mtimavalye, George N. Liomba *et al.* 1998. "Trends of HIV-1 and sexually transmitted diseases among pregnant and postpartum women in urban Malawi". *AIDS*, 12: 197–203.
- Temmerman, M.S. Moses, D. Kiragu, S. Fusallah, I. Wamola and P. Piot, 1990. "Impact of single session postpartum counseling of HIV infected women on their subsequent reproductive behaviour". *AIDS Care*, 2 (3): 247–52.
- Temmerman, M., M.S. Moses, D. Kiragu, S. Fusallah, I. Wamola and P. Piot. 1994. "Postpartum counselling of HIV infected women and their subsequent reproductive behavior". In M. Berer and R. Sunanda, eds., *Women, HIV, and AIDS*. London: Pandora Press.
- Thornton, Rebecca. 2006. "The demand for and impact of learning HIV status: Evidence from a field experiment". Mimeo. Harvard University.
- Topouzis, D. and J. du Guerny. 1999. *Sustainable Agricultural/Rural Development and Vulnerability to the AIDS Epidemic*. FAO and UNAIDS joint publication. UNAIDS Best Practice Collection. Rome: FAO, December.
- UNAIDS. 2000. "Evaluation of the 100% condom programme in Thailand: UNAIDS case study". http://data.unaids.org/Publications/IRC-pub01/JC275-100pCondom_en.pdf.
- UNAIDS. 2004. "Policy statement on HIV testing". Information note. http://data.unaids.org/una-docs/hivtestingpolicy_en.pdf.
- UNAIDS. 2005. "Evidence for HIV decline in Zimbabwe: A comprehensive review of the epidemiological data". http://data.unaids.org/publications/irc-pub06/zimbabwe_epi_report_nov05_en.pdf.

- UNAIDS. 2007. *2007 Report on the Global AIDS Epidemic*. http://data.unaids.org/pub/EPISlides/2007/2007_epiupdate_en.pdf.
- UNFPA. 2004a. *The New York Call to Commitment: Linking HIV/AIDS and Sexual and Reproductive Health*. New York: United Nations Population Fund. http://www.unfpa.org/icpd/10/docs/hiv_aids_rh_call_commitment.doc.
- UNFPA. 2004b. *Sexual and Reproductive Health & HIV/AIDS: A Framework for Priority Linkages*. New York: United Nations Population Fund. http://www.unfpa.org/upload/lib_pub_file/501_filename_framework_priority_linkages.pdf.
- Urassa, M., J.T. Boerma, R. Isingo, J. Ngalula, J. Ng'weshemi, G. Mwaluko and B. Zaba. 2001. "The impact of HIV/AIDS on mortality and household mobility in rural Tanzania". *AIDS*, 15 (15): 2017–23.
- Voluntary HIV-1 Counseling and Testing Efficacy Study Group. 2000. "Efficacy of HIV-1 counselling and testing in individuals and couples in Kenya, Tanzania, and Trinidad: A randomised trial" *The Lancet*, 356 (9224): 103–12.
- Wawer, Maria J., Nelson K. Sewankambo, David Serwadda, Thomas C. Quinn, Lynn A. Paxton, Noah Kiwanuka *et al.* 1999. "Control of sexually transmitted diseases for AIDS prevention in Uganda: A randomised community trial". *The Lancet*, 353: 525–35.
- Wawer, M.J., R. Gray, D. Serwadda, Z. Namukwaya, F. Sewankambo, X. Ki, T. Lutalo, F. Nalugoda, and T. Quinn. 2005. "Declines in HIV prevalence in Uganda: Not as simple as ABC". Paper presented at the 12th Conference on Retroviruses and Opportunistic Infections, Boston, 22–25 February.
- Weiss, H.A., M.A. Quigley and R.J. Hayes. 2000. "Male circumcision and risk of HIV infection in sub-Saharan Africa: A systematic review and meta-analysis". *AIDS*, 14: 2361–70.
- Werker, Eric, Amrita Abhuja and Brian Wendell. 2006. "Is AIDS an economic or a humanitarian disaster? Male circumcision, AIDS, and its impact in Africa". Draft. Harvard University.
- Williams, B.G., D. Taljaard, C.M. Campbell, E. Gouws, L. Ndhlovu, J. Van Dam *et al.* 2003. "Changing patterns of knowledge, reported behaviour and sexually transmitted infections in a South African gold mining community". *AIDS*, 17 (14): 2099–2107.
- Wojcicki, J. 2005. "Socioeconomic status as a risk factor for HIV infection in women in East, Central and Southern Africa: A systematic review". *Journal of Biosocial Science*, 37 (1): 1–36.
- World Bank. 1997. *Confronting AIDS: Public Priorities in a Global Epidemic*. New York: Oxford University Press.
- WHO. 2003. *WHO Declaration on Dual Protection: Male and Female Condoms and Spermicides*. Geneva: World Health Organisation. <http://www.who.int/reproductive-health/hrp/progress/59/news59.html>.
- WHO. 2004. *Reproductive Health Strategy to Accelerate Progress towards the Attainment of International Development Goals and Targets*. Geneva: World Health Organisation. <http://www.who.int/reproductive-health/publications/strategy.pdf>.

- WHO. 2006. Antiretroviral Drugs for Treating Pregnant Women and Preventing HIV Infection in Infants: Towards Universal Access. Geneva: World Health Organisation. <http://www.who.int/hiv/pub/guidelines/pmtctguidelines2.pdf>.
- Yamano, Takashi and T.S. Jayne. 2004. "Measuring the impact of working-age adult mortality on small-scale farm households in Kenya". *World Development*, 32 (1): 91–119.
- Yamano, Takashi and T.S. Jayne. 2005. "Working-age adult mortality and primary school attendance in rural Kenya". *Economic Development and Cultural Change*, 53 (3): 619–54.
- Yamano, Takashi, Yasuharu Shimamura and Dick Sserunkuuma. 2006. "Living arrangements and schooling of orphaned children and adolescents in Uganda". *Economic Development and Cultural Change*, 54: 833–56.
- Young, Alwyn. 2005. In Sorrow to Bring Forth Children: Fertility amidst the Plague of HIV. University of Chicago. <http://faculty.chicagogsb.edu/alwyn.young/research/Papers/InSorrow.pdf>.
- Zaba, B., E. Pisani, E. Slaymaker and J. Ties Boerma. 2004. "Age at first sex: Understanding recent trends in African demographic surveys". *Sex. Transm. Inf.*, 80: 28–35.
- Zambuko, Oliver and Akim J. Mturi. 2005. "The effect of the HIV/AIDS Epidemic on fertility in South Africa". Draft. School of Development Studies, University of KwaZulu-Natal, Durban, South Africa.

The Relationship Between Poverty and Maternal Morbidity and Mortality in Sub-Saharan Africa

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Good maternal health is of fundamental importance to a country's wellbeing and ability to prosper, and there are few times when maternal health is more at risk than in the period surrounding childbirth. Protecting the health of mothers during reproduction safeguards their future contributions to society and ensures the health and productivity of future generations. If the health of either mothers or their newborn offspring is compromised, there will be serious negative consequences for their families, communities, and the entire process of economic and social development. This is why the United Nations has set as one of its eight Millennium Development Goals (MDGs) the reduction of the maternal mortality ratio (MMR) by two-thirds in the developing world by the year 2015.

Some Definitions and Interactions

The MMR is simply the total number of maternal deaths occurring for a given number of births (typically 100,000), or equivalently, the total number of births times the obstetric risk of death per individual birth. It measures a woman's risk of death after becoming pregnant and carrying the child to term.¹ By most accounts, it is unlikely that sub-Saharan Africa will be able to reach this goal without a significant commitment of financial and intellectual resources. According to joint estimations by the World Health Organisation (WHO), United Nations Children's Fund (UNICEF) and United Nations Population Fund (UNFPA) for 2000, the MMR of maternal deaths per 100,000 live births was 920 in sub-Saharan Africa, compared with 20 among all developed regions and the worldwide average of 400. Despite the fact that Asia accounted for a slightly larger number of total maternal deaths than Africa, no other region in the world came close to the high mortality risk per birth found in sub-Saharan Africa. When the region's risk of mortality per pregnancy is combined with the prevailing fertility rate in the calculation of an individual's lifetime risk of maternal death, the disparity is even more pronounced. Over a women's lifetime the risk of maternal death in sub-Saharan Africa is 1 in 16, compared with 1 in 2,800 in the developed world, and 1 in 46 in the region with the next highest risk, South-Central Asia (WHO/UNICEF/UNFPA, 2004).

While data on acute maternal morbidity are less readily available, morbidity is far more prevalent than mortality. For example, a recent study of Kalafong and Pretoria Academic hospitals, catering for the delivery of indigent women in the Pretoria health region in South Africa, found that for every maternal death, there were five times as many near-misses – described as a patient with an acute organ system dysfunction that if not treated appropriately could result in death (Mantel *et al.*, 1998).²

Sub-Saharan Africa also has the lowest gross domestic product (GDP) per capita of any region in the world. There is no doubt that poverty in the region contributes to the significant disparities that exist in maternal morbidity and mortality (MMM) between sub-Saharan Africa and the developed countries. Indeed, there are many ways in which poverty might lead to high MMM, for example, extreme poverty is often associated with poor nutrition and diseases such as anaemia, which are significant risk factors during pregnancy. Poorer members of society may also have limited access to necessary antenatal medical care as well as appropriate medical resources during and after delivery. They may live in poorly ventilated, substandard dwellings without access to fresh water and be at greater risk of contracting malaria or parasitic infections that compromise a woman's immunity during pregnancy. Furthermore, a variety of demographic factors, such as young age at first birth and high overall fertility can increase the reproductive risks to mothers and their offspring.

A corollary of poverty and low levels of education, also adversely affects the health of both mother and child through a range of pathways. For example, education is paramount in determining the quality of care for children, as well as the ability to access and understand the benefits of health information. This includes messages imparted through schools, and also through other channels such as the print media. Even time preferences and the nature of the individual's discount rate may affect health, as well as subsequent economic outcomes, in important ways. If discount rates are lower among the wealthy and educated, they will take greater steps to ensure their longevity and demonstrate health preserving behaviours.

As with other factors influenced by poverty, poor maternal health outcomes can limit the future productivity of households and lead to further impoverishment. This creates a poverty trap in which mothers are more likely to die or become ill during or after pregnancy because they are poor, and more likely to be poor in the future as a result of negative health shocks during this period. Clearly, illness or death resulting from childbirth will limit a woman's future productivity in the labour market, but perhaps a more serious negative consequence of MMM is reduced productivity in domestic and caregiving activities.

The inability of mothers to care for their newborns greatly increases the risk of infant mortality or other adverse health events, which can have long-lasting consequences (Strong, 1998). Other household members are also inevitably affected by MMM. For example, the need for pre-existing children to take over the mother's

domestic and caregiving responsibilities can lower educational attainment and reduce future earning potential. This problem is particularly relevant to young girls, who are the likely substitutes for women in caregiving roles. The same girls who are therefore likely to withdraw from school are likely both to have high levels of fertility and to be primarily engaged in low skilled and low wage self-employment and home production. In any case, the relationship between MMM and poverty is multi-faceted and complex, necessitating a thorough investigation using a unified theoretical framework.

Before we proceed in establishing such a framework, we note that the clinical definition of maternal morbidity and mortality (MMM) is often defined in terms of a relatively narrow time frame surrounding childbirth. For example, according to the 10th revision of the *International Classification of Diseases* (ICD-10), maternal death is defined as: *the death of a woman while pregnant or within 42 days of the termination of a pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes* (WHO, 1992). The concept of maternal morbidity is, therefore, defined analogously by substituting *illness* for *death*. Because the 42-day limit is somewhat arbitrary, the ICD-10 also includes a second category for *late maternal death*, which is defined as *the death of a woman from direct or indirect obstetric causes more than 42 days but less than one year after termination of pregnancy* (WHO, 1992).

While these definitions are of considerable use for endeavours such as the collection of vital statistics, we find them too restrictive for our efforts. Rather, in this chapter we address more broadly the concern over maternal morbidity and mortality of women during their reproductive years and as a consequence of their reproductive experience, even if the health assaults occur outside the narrow definitions of the WHO. Likewise, our concern with the health and wellbeing of women in their reproductive years includes both indirect (e.g., malaria, anaemia, hypertension, malnutrition) and direct causes of morbidity and mortality such as severe bleeding and sepsis.³

The distinction between indirect and direct causes of maternal morbidity and mortality may be of some importance in terms of their causation, but it is important to note that the great majority of all these conditions could be prevented with proper medical care, information, and reproductive health services that alter the women's circumstances and behaviour, a point that we will stress in the later part of the chapter.

Theoretical Framework

In determining the causal pathways through which poverty affects MMM and vice versa, it is useful to formalise the process of individual health production using a general economic framework. This will serve as a basis for how poverty status interacts with the health of mothers and their newborn offspring. The basic

framework presented relies heavily on the standard neoclassical approach to utility maximisation at the household level. While this approach is fundamentally based on individual preferences and decisions, the significant pooling of resources and joint nature of decision making among members of the same household has traditionally led to the measurement of most economic variables at the household level. Assuming that the household can be treated as a single decision making unit also greatly simplifies the presentation of the underlying theoretical model. For this reason, as well as to maintain consistency with the data, the unitary household model is still in wide use in both the theoretical and empirical development economics literature.

Of course, the model is only strictly appropriate if all household members share the same preference structure or the household head is able to impose his/her will on the other members in a perfectly dictatorial fashion. These assumptions are surely violated in some situations, but they remain reasonable approximations to reality in others. Rather than presenting a multitude of different models, we lead with the unitary model, followed by a brief discussion of intrahousehold bargaining models that allow us to consider the fact that preferences are likely to differ among household members. In addition, we point out cases throughout the analysis where the latter approach is most relevant.

Although there are many similar versions of the unitary model, we use that of Behrman and Deolalikar (1988) as the basis for our formulation. Theirs is a household-farm production model along the lines of those discussed by Singh *et al.* (1986), in which the household engages in agricultural production as well as the production of health, nutrition, productivity, and children. First, assume that household preferences can be represented by the following utility function:

$$U = U(H_i, C_i, S, T_i^L, E_i^c, B^s, \xi) \quad i = 1, \dots, I \quad (1)$$

where H_i is the health of household member i , C is the household's consumption bundle, S is shelter (housing characteristics) and living environment, T_i^L is household member i 's leisure time, E_i^c is the educational attainment of child i , B^s is the number of surviving children in the household, ξ is a vector of taste norms, and I denotes the total number of household members. Note that some of the arguments of U are vectors. For example, consumption, C_i , includes each household member's consumption of food, non-food goods, services and consumption flows from the household's stock of durable assets.

As part of the utility maximisation process, the household is involved in the production of various inputs to utility. The production process we are most concerned with corresponds to the individual health of mothers and their family members. Following Grossman's (1972) model of health as a stock variable, we assume that maternal health is both produced and maintained by investments made in the current period, which when combined with the previous period's health stock generates current health status:

$$H_{it} = H(H_{it-1}, N_{it}, C_{it}, T_{it}^H, E_{it}, M_{it}, S_t) \quad (2)$$

We will generally suppress all time subscripts, but we use them here to demonstrate the dynamic nature of health accumulation. In addition to the previous period's health stock, the mother's current health is a function of nutrient availability, N_{it} , consumption goods, shelter and living environment, time devoted to the maintenance of health, T_{it}^H , her education, and consumption of medical services, M_{it} . Through backward recursion, current health is therefore a function of all previous values of these inputs as well as the genetically determined initial endowment of health and other physical attributes, η_i .

Closely related to the production of health is the production of nutrients, a key input into the health production function:

$$N_i = N(C_i, E_M, T_M^H, S) \quad (3)$$

In (3) T_M^P denotes the mother's time spent in home production including the preparation of food. While nutrient production is primarily a function of food consumption, the mother's skill or education level, time spent processing and preparing food, and food storage and sanitation facilities captured by S all affect her ability to extract nutrients from raw food inputs. The mother (food preparer's) skills and time also enter into nutrient production functions of other household members.

Both health and nutrition are also related to fertility and the mother's ability to successfully carry a child to term. However, the fertility decision is a joint one between the reproductive couple, and is influenced by the father's nutrition and health status as well as the education levels of both the mother and the father, their genetic endowments, and their access to contraception and family planning services, C^C . Therefore, the production function for births can be written as

$$B_{M,F} = B(H_M, H_F, N_M, N_F, \eta_M, \eta_F, E_M, E_F, C^C; \xi) \quad (4)$$

Not all of the children who are born will survive past one year of age (the typical threshold used to measure infant mortality). If we let H_c^* denote the critical level of health status required for the survival of child c , then the number of surviving children in the household is

$$B^S = B_{M,F} - M(H_c^* - H_c^*) \quad c = 1, \dots, I_c \quad (5)$$

where $M(.)=1$ if $H_c^* - H_c^* \leq 0$ and 0 otherwise.

It is also possible that the mother may die or become ill during pregnancy, delivery or the postnatal period. The mother's mortality function is likewise

$$M_M = M(H_M - H_M^*) \quad (6)$$

The morbidity function indicating sickness is defined analogously, except that the threshold level of health status corresponding to sickness is higher than that corresponding to death.

In the developed country context where markets are more complete and nutrient availability is less constrained, the framework given above would likely be considered sufficient to model health production, nutrition and fertility with the household's other consumption decisions. Such separability between consumption and production, or factor markets, may not apply in certain African contexts for two main reasons: many rural households in Africa engage in both own-account agriculture and the cultivation of cash crops, so their food consumption and production decisions are jointly determined; and, nutrient availability is more variable and often reaches levels at which health and labour market productivity are adversely affected. In these circumstances, labour market productivity and agricultural production will ideally be modelled jointly with household consumption decisions.

The hypothesis that nutrition and health have some impact on labour market productivity has become widely accepted among development economists, although the level and nature of this relationship is still subject to debate. Two facts are clear: There is a high incidence of malnutrition and infectious disease in many developing countries, and there is a high reliance on physical strength and stamina in most income-earning activities, including non-wage work such as own-account agriculture. It is widely acknowledged, on the basis of both theoretical and empirical work, that average productivity per worker is reduced by lower average health status.

To amplify, the efficiency wage hypothesis (Stiglitz, 1976; Bliss and Stern, 1978) have made clear the theoretical foundations of the relationship between health and productivity, and thus employment, labour supply and wages.⁴ In a review of research related to this efficient wage hypothesis, Strauss and Thomas (1998) conclude that while poor health does not appear to result in widespread involuntary unemployment, moderate to severe health problems do reduce productivity and labour supply. They also conclude that the balance of evidence points to a positive effect of nutrient intakes on wages.

In order to capture health and nutrition impacts on productivity, the wage is modelled as an endogenous variable dependent on consumption decisions impacting health and nutrition. Thus,

$$P_i^L = P^L(H_i, N_i, E_i, LM, \eta_i) \quad (7)$$

where P_i^L is the individual's wage (or shadow valuation of time) and LM represents local labour market conditions. In situations where labour markets are functioning efficiently and chronic malnutrition is rare, as in some urban areas, the wage could be treated as exogenously determined by prevailing labour markets. However, this is not often the case for rural farm households, either because they are subject to fluctuations in nutrient intake or because labour markets are functioning poorly.

It is also necessary to account for the household's production decisions related to agriculture, or possibly the informal service or manufacturing sectors. Output from

the household's farm (or firm) is a function of a variety of household characteristics and productive inputs, such that:

$$Y = Y(H_i, N_i, E_i, T_i^L, \eta_i, K, A, L, S) \quad i = 1, \dots, I \quad (8)$$

where T_i^L represents the time devoted to farm/firm production (by both adults and children), K is capital stock and land, which is either owned by the household (K^H) or rented (K^*), A is a vector of intermediate inputs to the production process, and L is hired labour. In contrast to hired labour, the household's labour input is substituted out of Equation 8 as a function of health status, nutrient intake, education level, endowments and time input. While it is assumed that the household can go to the external labour market to hire workers of a given quality, the quality of family labour is determined jointly with consumption decisions and health production. In many cases, it may be reasonable to assume that family members' labour is perfectly substitutable for hired labour. If a household member experiences a significant drop in health status, however, a given hour of their labour will no longer contribute as much to output as an hour of hired labour.

When maximising utility and farm/firm profits, the household faces both a time constraint and a budget constraint. The time constraint states simply that time devoted to all activities cannot exceed T_i , the total allowable time during the day:⁵

$$T_i = T_i^H + T_i^E + T_i^P + T_i^L + T_i^W + T_i^F \quad (9)$$

Thus, total time is devoted to health maintenance activities, education, home production, leisure, the external wage labour market or farm production, respectively.

The budget constraint is simply an expression of the total resources available to the household and a description of how they can be spent. One important component of total resources is farm profits, which is expressed as:

$$\Pi = P^Y Y - P^A A - P^{L^*} L^* - \sum_i P_i^L T_i^F - dK^H - rK^* \quad (10)$$

where P^j represent various output or input prices, d is the depreciation rate on owned capital, and r is the rental rate on hire capital. The other component of total resources is the value of each household member's time, $\sum_i P_i^L T_i$. Incorporating

both total human resources and financial resources into one "full income" constraint yields the following exhaustive representation of household resources and expenditures:⁶

$$\Pi + \sum_i P_i^W T_i^W + R + \sum_i P_i^L T_i \leq PC + P^C C^C + P^S S + P^M M + \sum_i^{I_c} P_i^E E_i + \sum_i P_i^L T_i^L \quad (11)$$

where R denotes lump sum transfers, and leisure consumption is defined by the identity:

$$T_i^L = T_i - T_i^H - T_i^E - T_i^P - T_i^W - T_i^F$$

In the most general case where commodity and labour markets are incomplete to the point that commodity prices and market wage rates are endogenous to the household's decisions, maximisation of our system of equations subject to the budget constraint represents a complex process with many simultaneously determined factors. We have formulated the model under the common, and typically defensible, assumption that the household is a price taker in both the goods and hired labour markets. However, we have allowed for the possibility that each household member's wage rate is endogenous to consumption decisions and health production. In the case where all wages are predetermined, the household's goods consumption and farm production activities can be solved in a recursive fashion (Singh *et al.*, 1986). First, the household's farm profit function is maximised over labour, intermediate, and other production inputs. The optimised value of inputs is then substituted back into the farm profit function and household utility maximisation proceeds with respect to the full income budget constraint with recursively determined farm profits.

Therefore, recursive estimation results in a set of commodity demands that are a function of full income and underlying farm profits. As a result, a change in the price of a commodity that is both consumed and produced will have a profit effect in addition to the typical substitution and income effects. Under these circumstances an increase in price could result in an increase in consumption rather than the textbook decrease in consumption consistent with the law of demand under complete and fully efficient markets. However, if consumption decisions do result in productivity effects on the household labour input, recursivity is broken by the fact that the marginal revenue product of family labour (T_i^F) is a function of an endogenously determined wage rate (P_i^L). Although many of the results from the simplified recursive model will still hold, simultaneity in production and consumption must be taken into account to reveal the implications of the more general model.

In the simplified case where $P_i^L = P^*$ is exogenously determined, recursive farm profit and utility maximisation results in commodity demand that takes the following familiar form:

$$C_i = C(P, P^*, P^C, P^E, P^S, Y^*, \eta_i, \xi) \quad (12)$$

where Y^* is full income reflecting profit maximisation. The demands for S , C^C , E_i^C and M_i , and the labour supply or leisure demand functions corresponding to T_i^H , T_i^E , T_i^P , T_i^W , T_i^F and T_i^L are all defined analogously. These demand functions are then substituted into H_i , N_i and B_i to generate "derived demands" for health, nutrition and births. In contrast, when household productivity is endogenously determined, P_i^L and P^* appear separately in (12) and the former is treated as an endogenous variable. Nonetheless, one can substitute out all of the endogenous variables in each demand equation to obtain a reduced form set of demand equations. Because of the simultaneity of production and consumption, each endogenous variable will be a function of all the exogenous variables in the system, including prices, the rental

and depreciation rates for capital, initial endowments, predetermined (parental) education, owned capital, lump sum transfers, and taste norms.

While the common preference, or unitary model, can be used to describe household behaviour in a large number of situations, intrahousehold bargaining models are sometimes more appropriate to the underlying behavioural process. An intuitive review of household bargaining models is provided by Strauss and Thomas (1995) based on the groundbreaking work of Chiappori (1988, 1992). The underlying premise of these models is that preferences among different household members are not uniform, implying that each member will seek to allocate resources over which they have control to the goods they most prefer. Since resource allocations must be negotiated with other household members, control over a greater proportion of resources increases a member's bargaining power relative to others. One household member will typically bring more resources to the household than others and emerge as dominant, but all members have a fallback position in the event of non-cooperation. If the household were to dissolve, each member would be able to keep a certain percentage of the household's total resources for themselves. The utility they would derive from such non-cooperative behaviour is known as the threat point. Therefore, if the bargaining outcome between members results in a total allocation of utility that is below the sum of all individual member's threat points, non-cooperation will ensue (Ulph, 1988; Lundberg and Pollak, 1993). Any gains above this level of utility resulting from a cooperative solution will be shared among household members in accordance with the relative bargaining strength of each.

There are several different forms of intrahousehold bargaining models depending on the level of complexity of assumed interactions. The Nash cooperative bargaining model is the most common (McElroy, 1990; McElroy and Horney, 1990). The identification of these models usually necessitates having information on resources controlled by each family member. In the common case of the husband-wife model, it is often difficult to obtain such information for wives who do not work in the wage labour market. One approach that has been attempted in the past is to use household assets originating from the wife's dowry or from women's earnings in agricultural activities that are culturally gender differentiated (Hoddinott and Haddad, 1995). Other attempts to deal with the endogeneity of men's and women's incomes include using various forms of non-earned income, such as gender-specific transfers or assets (Sahn and Gerstle, 2004; Thomas 1990, 1993). If suitable individual-specific resource information is available, bargaining models can be used to determine household demand levels that reflect the divergent preferences and relative bargaining power of different household members. These demand levels may be very different from those predicted using the unitary model if the husband and wife's preferences are sufficiently divergent, and the wife has control over a nontrivial share of total resources.

Poverty and Maternal Health

The strong correlation between poverty and maternal health indicators at the country and regional levels suggests that living in poverty greatly increases the risk of illness for pregnant women and those with newborn offspring. This association is also observed within developing countries across different poverty levels. For example, Graham *et al.* (2004) examine the relationship between poverty and maternal death in ten developing countries (six in Africa) and find that the proportion of women dying of maternal causes increased consistently with the poverty quintile.

Using the theoretical framework presented above, we will discuss the most important pathways through which poverty affects MMM. If poverty does impact maternal health, we know that it must be through the arguments of the health production function in Equation 2. These are current and past consumption of medical services, other commodities, housing, nutrient intake, the time devoted to health maintenance activities, and educational attainment. While some of the literature looks at the impact of poverty, or income, on health status in a reduced form sense, we will begin by describing aspects of the literature that shed light on how poverty influences each input to maternal health. In some cases very little empirical research is available on these pathways, but strong connections can still be inferred from the theory and empirical research on health outcomes in general.

The Demand for Medical Care

One of the most direct inputs into the production of health is the consumption of medical care. The medical services considered most relevant to the prevention and treatment of MMM are recommended antenatal care, medical assistance during delivery and follow-up postnatal care from a qualified medical provider. A number of studies, reviewed by Carroli *et al.* (2001), have documented the importance of antenatal care in preventing poor maternal health and infant outcomes in developing countries. Similarly, Koblinsky (2003) finds that assistance by a skilled birth attendant or medical professional during delivery is associated with a significant decline in maternal mortality. Therefore, access to maternal health services stands to play an important role in the production of maternal health.

Since health is a stock variable, past investments in health are also important determinants of current health outcomes. A mother's access to and consumption of health services leading up to pregnancy is necessary for the identification and treatment of conditions that can greatly increase the risks associated with childbirth. For example, the treatment of sexually transmitted diseases, urinary tract infections or malaria prior to pregnancy can greatly improve a woman's chances of a healthy pregnancy and delivery. In addition, Tsu (1994) contends that antenatal care is crucial to the detection of elevated delivery risks and the referral of women to medically assisted delivery environments, suggesting the cascading effect of medical care utilisation occurs right up to the point of delivery. Therefore, general

results from the literature of the relationship between medical care demand and poverty are just as important as those specific to reproductive health services.

Two major strains in the literature explore explicitly the link between health care utilisation and poverty. The first, which is largely descriptive in nature, is the work on fiscal incidence. Studies on fiscal incidence demonstrate how expenditures on reproductive and related health services are distributed among households, and thus the extent to which they reach the poor. The second falls in the domain of behavioural analysis; this involves the exploration of how individuals or households alter their behaviour in response to a policy change. Such analysis is typically conducted using empirically identified demand functions. These allow one to investigate the effects of prices and the quality of health services on access to care, and to determine consumers' willingness to pay for publicly subsidised health care.

Fiscal incidence

Fiscal incidence describes who benefits from public expenditures, such as reproductive health services (Selden and Wasylenko, 1992; Van de Walle, 2003), and therefore indicates the impact of these services on an individual's welfare, or the welfare of different groups of individuals. More specifically, benefit incidence analysis enables us to determine the overall progression of public spending on services such as reproductive health care. Furthermore, this assessment of progression can be done both in terms of whether a given service is more progressively distributed relative to the often skewed income or expenditure distribution, or relative to the higher standard of benefits falling disproportionately upon the poor in absolute terms. It is generally focused on the economic rather than statutory incidence of spending, since the former largely describes who is meant to benefit by a law and the latter who actually receives the benefits. Furthermore, in the assessment of who generally benefits in terms of utilisation or access to health services, measurements are typically made using the income equivalents of the services to allow aggregation across services.

Conducting a study of expenditure incidence first requires a valuation of the private benefits that accrue to an individual as a result of a particular type of government expenditure, such as on reproductive health services. While ideally we would use demand functions to estimate the value of these services, this is complex and we therefore generally employ a first-order approximation of the government's cost of providing the service. For some health expenditures, deriving a monetary estimate is straightforward. For example, a visit to the family planning clinic can be valued using the market cost of the birth control device, and the unit cost of providing the service as determined by budget data, including the cost of personnel, facilities and so forth. If the service is associated with a payment by the consumer, the monetary value is simply the subsidy rate multiplied by the cost of delivering the service. Where this process gets complex is in determining the (private) value of a service provided, especially when the government is the sole provider of the service, and

services are rationed. Likewise, it is difficult to value externalities associated with health service provision.

Once the value of services is determined, the second step is to determine whose welfare increases as a result of receiving the services provided. To do this, we initially must rank individuals in the population by per capita or some similar adult equivalent measure of total expenditures, which provide us with a picture of the welfare distribution prior to receiving the service or subsidy.

The final step is then to determine whether the distribution of income is the same, worse or better after the value of the service or subsidy is distributed across the same ranking of the population. In making this comparison, it is possible to employ an index, such as a Gini coefficient, to reduce the information from a continuous welfare distribution to a single value. Thus, we compare aggregate welfare with and without valuing the public expenditure as part of an individual's welfare. Given the arbitrary nature of the choice of indexes, however, the use of tests of stochastic dominance in comparing concentration curves is generally preferred (Yitzhaki and Slemrod, 1991). A concentration curve is similar to a Lorenz curve in that it graphs the cumulative share of the sample, from poorest to richest, on the horizontal axis, against the cumulative share of benefits from a given service or subsidy on the vertical axis. Public services whose benefits are more concentrated among the poor will have higher (more convex) concentration curves, and vice versa. We can also compare the concentration curves with other benchmarks: a Lorenz curve for per capita expenditures and the 45-degree line.

There is a large literature, both theoretical and empirical, on conducting incidence analysis (Van de Walle, 2003). The work by Sahn and Younger (2000) is notable among this literature because it provides a cross-country examination of a range of services, including public and private health services that are both primary and hospital based. The general picture emerging across many different studies is that public health services tend to be more progressive, in contrast to private health services and tertiary care. When such analyses disaggregate public service provision to a lower level they tend to find no statistical difference in terms of the progression of services accessed by men and women. Virtually absent in the literature, however, is incidence analysis that focuses on women's use of reproductive health services, such as family planning, or pre- and postnatal care.

While incidence analysis is often considered an attractive research area, the limitation of this approach is that it is static, capturing the situation given the policies and conditions that are prevailing at the time that data are collected. It is impossible, however, to use such information to simulate the impact of how households or individuals will respond to policy changes. Thus, while quite common among researchers, development practitioners and programme planners, it is perilous to formulate policy recommendations without an appropriate counterfactual analysis.

Demand analysis

Econometric studies of demand behaviour allow us to determine how individuals respond to alternative policies, and to fluctuating market conditions, through the use of standard comparative statistics results. More specifically, we can assess the impact of policy changes on service utilisation, conditional upon a wide range of individual, household, community and clinic characteristics at various points in the income distribution. Furthermore, this type of exercise allows us to value public services as well as assess their costs. Valuations can be made specific to subgroups defined by income, race, ethnicity, location, and so forth, making it easier to determine how best to encourage vulnerable members of the population to access desirable public services.

The demand functions for medical care specified in the form of Equation 12 suggest that prices and (recursively determined) full income are the primary economic determinants of utilization.⁷ Therefore, estimates from structural medical care demand that models of price and income effects should allow one to determine the impact of poverty, or low income levels, on the demand for medical care and production of health. Other socio-economic determinants may also be important in the sense that they are correlated with both poverty status and the demand for medical care. While the literature on non-economic factors is somewhat less conclusive, we will review some of the findings for Africa to aid variable selection in demand functions.

A number of researchers have investigated medical care utilisation among the poor in developing countries, primarily in the context of how access to care is influenced by user fees and distance to health care providers. User fees, or fixed charges per visit/procedure, became an important issue for developing country health delivery systems beginning in the mid 1980s when a number of countries with fully subsidised medical services began to impose levies on their citizens in order to help finance the public provision of medical care. Because user fees are generally not means tested they are regressive in the sense that they represent a larger share of a poor household's income than a wealthier household's income. This would be the case even if the price responsiveness of medical care was invariant across all members of the population. However, the regressive nature of user fees is compounded by the fact that several researchers have found that higher prices for medical care reduce utilisation by the poor proportionally more than by wealthier individuals.

For example, Gertler *et al.* (1987) find that medical care demand becomes less price elastic as income rises in Peru. Meyerhoefer *et al.* (2007) conducted user fee simulations in Vietnam and similarly found that their removal would substantially increase access to publicly provided medical care in both hospitals and clinics. Again, owing to the declining relationship of medical care price elasticities with income, this improvement in access would be most beneficial to those below the poverty line.

Similar results have been reported for Africa. Deininger and Mpuga (2005) found that the removal of user fees in Uganda led to improved access to care by the poor and a reduction in the probability of sickness, presumably through better access to preventative health services. Similar evidence from other African countries, such as Ghana (Waddington and Enyimayew, 1990), Kenya (Mwabu *et al.*, 1995), Swaziland (Yoder, 1989) and Zambia (Kahenya and Lake, 1994), indicate that there are significant declines in the use of public clinics subsequent to the imposition of user fees.

Although none of these studies is focused specifically on the demand for maternal health services, it is reasonable to assume that the same relationship between price and demand that holds for medical care in the aggregate applies to these services as well. Therefore, increases in the price of maternal care presumably limit access by the poor more than the wealthy, making the poor particularly vulnerable to the imposition of user fees for reproductive health services.

One might argue, however, that user fees are not the true rationing mechanism for medical care in developing countries. Even in places where user fees are zero, access to health services is often limited by the substantial distances many households must travel to reach public medical facilities. This is especially true in rural areas, where a large proportion of the population lives below the poverty line. Dor *et al.* (1987) have likewise demonstrated, using data from rural Côte d'Ivoire that, the familiar curvature in price elasticities holds for travel distances as well. In particular, poorer individuals are significantly more travel time elastic than wealthier individuals, so even non-monetary access costs are a bigger limiting factor for the poor. This result is confirmed by Sahn *et al.* (2003) using data from Tanzania when travel distances are translated into forgone labour earnings.

The only study we are aware of that estimates the demand specifically for maternal health services in Africa is by Overbosch *et al.* (2004). Using data from Ghana, they measure the impact of socio-economic variables, the cost of care and the distance to medical providers on the demand for antenatal care. While they do not provide elasticity estimates by poverty status, they do find that lowering the price of care to zero increases the likelihood that a woman will visit a trained physician the recommended number of times (four) prior to delivery. This effect, however, is small relative to the removal of travel costs to doctors' offices, which increases the share of mothers who purchase or receive at least four doctor visits by 5.1 percentage points. The provision of basic education to all increases the proportion of mothers who receive sufficient antenatal care, by a doctor, midwife or nurse, by 10.9 percentage points. Consistent with previous studies, their relatively large effects for distance and education level suggest that the poor, who live in rural areas relatively further from most providers and are less educated, on average, are significantly less likely to receive recommended levels of antenatal care than others.

While most policies aimed at increasing access to health care by the poor operate through lower prices or increased provision of services in rural areas (to reduce

travel costs), income also has a direct and distinct impact on the demand for medical care. It is widely recognised at this point (and confirmed by all the studies mentioned above) that medical care is a normal good, and so has a positive relationship with income. While the magnitude of the income effect varies from one study to another, the implication of nearly all the studies is that economic growth improves access to medical care, and consequently, maternal health services. This result is not very surprising, but it does suggest that the demand for care is such that individuals prefer more of it even at relatively high levels of income.

While the issue of quality in the provision of medical services is notoriously difficult to address owing to the lack of data on treatment implementation, some of the studies noted above indirectly address quality by investigating the demand for care across a range of providers. Physicians are assumed to provide higher quality care than midwives or nurses. Likewise, hospitals and private facilities generally offer more comprehensive and better treatment than public clinics. By looking at utilisation patterns among the different providers across poverty status, one can infer whether there is differential access to high quality services. For example, Meyerhoefer *et al.* (2007) find that utilisation of lower quality providers (public clinics and self-care) is much higher among the poor than that of higher quality public hospitals. They do find, however, that utilisation of private facilities is fairly constant across poverty levels, which suggests that the poor do have equal access to this one presumably higher quality treatment option.

Overbosch *et al.* (2004) report that utilisation of antenatal care is highest for midwives in Ghana, but that simulations to improve access to care, reduce travel distances, and remove user fees led to greater demand for higher quality doctor visits (for the entire sample), implying that those who have the financial means to overcome access and cost barriers enjoy better access to higher quality care. Results from Sahn *et al.* (2003) suggest that demand for health services in Tanzania would increase if people had the option to seek out a better doctor/nurse, get access to pharmaceuticals, and attend a health centre, clinic or dispensary that is cleaner and has a toilet, water and a roof. While improvements in the quality of doctors/nurses in public clinics and dispensaries appear to increase the demand for treatment in private clinics, many doctors and nurses working in public clinics often have private practices.

In addition to the economic determinants of medical care utilisation, poverty status is often associated with certain socio-demographic factors that are correlated with demand. For example, a number of studies have found that parity effects are strongly correlated with the use of antenatal care. In particular, women of low parity, particularly those having their first child, are more likely to utilise antenatal care than those of high parity (Pebley *et al.*, 1996; Raghupathy, 1996; Magadi *et al.*, 2000; Short and Zhang, 2004). While some of the authors hypothesise that women with previous birthing experience may have a lower perceived need for care, it is also the case that poorer women tend to have higher fertility rates.

A more direct proxy for lower socio-economic status, education level, has also been revealed to be correlated with the use of maternal health services. For example, Obermeyer and Potter (1991), Bhatai and Cleland (1995), Raghupathy (1996), and Short and Zhang (2004) all find that higher levels of parental education are associated with greater use of services.⁸ Short and Zhang further find that lower socio-economic status, such as captured women's occupational characteristics, is associated with the use of formal delivery assistance. Finally, Magadi *et al.* (2000) include information on whether pregnancies were mistimed or unwanted and find a significant negative impact of these categorisations on antenatal care use in Kenya. In estimating this effect they control for the age of the mother and find teen mothers to be less likely to seek care. Given that the poor are presumably most susceptible to mistimed and unwanted pregnancies, particularly at a young age, these factors can be viewed as further evidence of the negative impact of poverty and low socio-economic status on access to and utilisation of maternal health services.

While the focus of the previous discussion was on health care utilisation, as we discuss elsewhere, the next link in the chain in terms of how access to care affects health status is even more difficult to quantify and has been the subject of even less research. The impact of the price of health care on health care outcomes was explored, for example, by Dow *et al.* (1997) in the United States and Indonesia using data from randomised experiments conducted in the two countries. They find that objective health measures, particularly activities of daily living, worsen as prices increase. Clearly, the data and methodological challenges of running experiments, let alone relying on non-experimental data to address the causal effect of health care prices on demand for services and health outcomes, constitute a major constraint, but one with potentially very high benefits.

Efficacy of public expenditures

An analysis of behaviour is clearly important for gaining an understanding of the efficacy of public expenditures, and the extent to which reproductive health services, for example, reach vulnerable women. There are, besides, other important aspects of public services provision that reach beyond their impact on individual behaviours. In particular, questions remain about the economic and administrative efficiency of the services provided. For example, we need to know how efficient public spending is in translating expenditures into the goods and services that they intend to provide.

Regarding the issue of efficiency, there has been a considerable amount of attention focused on this question, especially in the form of tracking surveys that examine the flow of resources from their source to the point of service. Budget allocations may not be the best indicator of the supply of public services in developing countries with poor accountability and weak institutions. Governments may spend on the wrong goods and people; money may fail to reach frontline services; if money does reach the frontline, incentives to provide the service may be weak; and finally, even if services are provided efficiently, households may not take advantage of them. In

combination, these considerations will determine the efficiency of the services delivered. Of course, there is the additional issue of whether, and to what extent, the goods and services provided actually translate into better reproductive health outcomes among the intended recipients, a question that is far more complex and dealt with elsewhere when we talk about behaviour and assessing outcomes.

Regarding the issue of whether the money reaches the frontline service, there remains limited research focused on this question. The general form of such efforts – public expenditure tracking surveys (PETS) – examines the flow of resources from the source to the point of service.⁹ These types of surveys are particularly valuable for quantifying leakages of funds, capture of resources by politicians and bureaucrats, and problems related to the availability and actions of staff and materials (such as pharmaceuticals).

Even more limited is the research on the extent to which the services are provided conditional upon money reaching the clinic or school. For example, absenteeism may be widespread because of low pay and lack of incentives and oversight of local service providers, such as doctors and nurses. This question is generally addressed using tools such as quantitative service delivery surveys (QSDS). These types of surveys collect information on both the *agent* who is responsible for service delivery, and the *principal*, such as the ministry of finance, that allocates the resources to the local level. In both types of research, the emphasis is on measuring provider incentives and behaviour through the appropriate survey instruments.

Great care is required in conducting both PETS and QSDS, given that the characteristics of public service providers and the nature of tasks make it difficult to evaluate performance. The multiplicity of tasks done by the service providers, unobservable actions and outcomes, lack of input and output data, and difficulty in the measurement of output are major constraints in measuring the effectiveness of public service delivery. Tracking surveys explicitly recognise that the officials in charge of service delivery also have strong incentives to misreport (or not report) key data. Therefore, data collection strategies are designed to rely on different sources for the purposes of cross-validation. The facility or frontline service provider is typically the main unit of observation. Data are also collected from facility records, as well as from local, regional and national provider organisations (Dehn *et al.*, 2003).

Tracking surveys are distinct from other existing survey approaches, such as facility modules in household surveys or empirical studies to estimate demand functions. As we note above, demand analysis focuses on the response of the household to existing conditions. But those models afford little attention to the question of why quality and access are the way they are. Similarly, in most facility-based surveys, information collected relies on the knowledge of one or more informed individuals. Information supplied by informants therefore depends on the perception and expectations of a few individuals. The data are thus subjective in nature and sensitive to respondents' expectations. By contrast, the PETS or QSDS approach

emphasises and quantitatively measures provider incentives and behaviour. Non-sampling error (caused by poor survey implementation) is more of a concern using the PETS-QSDS approach than sampling error, as the data are often in a highly disaggregated form and hence labour-intensive to collect.

There are a number of African examples of tracking surveys that provide great insight into the efficiency of service provision. This research provides some good insight, in terms of both findings and methods. The fact that previous work has not included the provision of reproductive health services highlights a potential area for future research. Worth noting among the tracking surveys was that the first of its kind, conducted in 1996 in Uganda. The study focused on the education sector and found that on average, only 13 per cent of the annual capitation (per student) grant from the central government reached the schools in 1991–1995. By 1995, the proportion had only increased to 20 per cent (Reinikka and Svensson, 2002a/b). About 20 per cent of teacher salaries were paid to ghost teachers – teachers who never appeared in the classroom (Ablo and Reinikka, 1998; Reinikka, 2001).

In response to this finding, the government instituted an information dissemination campaign on the provision of public funds for schools, which greatly reduced the losses in the system from the estimated 80 per cent in 1995 to 20 per cent in 2001 (Reinikka and Svensson, 2003).

Other studies from Africa, including those from Tanzania and Ghana (Reinikka and Svensson, 2002a/b), have also looked at health care expenditures. In the case of the former, local (district) councils diverted a large part of funds disbursed by the central government to other uses and private gain. Leakage was estimated at 57 per cent in education and 41 per cent in health care. And in the case of Ghana, only about 20 per cent of the non-wage public health expenditure reached the frontline facilities. While these studies were looking more broadly at the health sector, there is clearly scope for similar research that focuses on reproductive health services more specifically.

Fertility, Maternal Health and the Demand for Children

The relationship between MMM and fertility is a complex one that operates through a multitude of pathways linking health, nutrition, labour supply decisions and household preferences for children. Much of the literature on poverty and fertility has investigated macroeconomic relationships between economic growth and fertility rates. Studies using long time series of historical data, such as those by Dyson and Murphy (1985) and Kremer (1993), suggest an inverted U-shaped relationship between economic development and fertility, whereby fertility rates increase at low levels of income, but decrease as aggregate income increases. The turning point in this relationship is often referred to as the demographic transition, which is preceded by falling mortality and corresponds to increasing levels of investment in the quality of each child rather than production of a larger quantity of children. Tabata (2003) has also demonstrated that incorporating preferences for the

quality versus quantity of children into an economic model of growth and fertility results in the familiar U-shaped relationship where fertility rates decline as investments in education and other forms of human capital increase. Likewise, there is considerable support in the literature for the so-called replacement hypothesis, in which lower child mortality is seen as effectively contributing to reduced fertility. Indeed, several papers have explicitly examined this question, such as that by Ben-Porath (1984), who reports that higher expected mortality increases the number of birth and shortens birth intervals. Likewise, Olsen (1980) finds that replacement is a significant factor and that higher child mortality contributes to greater fertility.

While broad-based theoretical and empirical studies suggest that both fertility and child mortality rates decline with economic growth in the aggregate, researchers have identified some differences across subsets of poor countries. For example, studies from the 1960s and 1970s in a number of South/Southeast Asian countries found a negative relationship between poverty and fertility (Aassve *et al.*, 2005). In a recent study of 25 countries in sub-Saharan Africa, however, Schoumaker (2004) found that fertility generally declined with poverty levels. These inconsistencies in the macroeconomic evidence are likely a reflection of heterogeneity in the poverty–fertility behavioural relationship at the micro level, and it is this level where we would argue that research opportunities – and potential policy relevance – are greatest.

The conventional explanation of high fertility among poor agrarian households is that large families are needed to provide inexpensive labour for agricultural production, and that children serve as a form of old-age insurance for their parents. Despite the initial perception that poor households are less likely than wealthier ones to be able to support additional children, economic theory predicts fertility decisions are made by comparing the marginal productivity of each additional child with the cost of supporting it. As long as productivity exceeds cost, parents will continue to reproduce.

However, parents' forecasts of their children's future productivity are certainly less than perfect, and health shocks can play a significant role in a child's ability to contribute to the future productive activities. Furthermore, the decision to have children is made jointly with production decisions and, in accordance with Equation 4, is influenced by a multitude of difficult to observe factors such as parental health endowments, contemporaneous maternal health status, and knowledge of contraceptive and family planning services. Failure to account for unobservables and the joint nature of the fertility/agricultural production process will lead to biased estimates of the fertility production function and confound estimates of the impact of poverty on fertility. To date, few if any studies have accounted for these factors, and thus our limited knowledge in this area is based on simple correlations or biased estimates of true underlying relationships.

One area where there has been a fair amount of research is on the impact of maternal health and family planning services and contraceptive use on the

production function for births. Not surprisingly, increased use of contraceptives and family planning services is negatively associated with fertility rates. In fact, some have gone so far as to credit these programmes with being major factors in the fertility transition of some developing countries (Cleland *et al.*, 1994). There is also an interaction between contraceptive use and access to maternal health care in the birth production function. Using a latent variable structural equation model (SEM) to control for the simultaneity, Ahmed and Mosley (2002) find that the use of maternal-child health care and contraceptives are significantly associated, independent of other determinants. They interpret this as a reflection of the household's desire to jointly increase the quality of medical care for mothers and their infants and limit family size. The positive correlation suggests the two types of utilisation are reinforcing so that improving access to health care during the reproductive process actually helps to limit future fertility. This is consistent with previous findings by Warren *et al.* (1987), Monteith *et al.* (1987), and Potter *et al.* (1987).

Investigation of fertility dynamics is important in its own right, but we are most interested in how changes in fertility, particularly those that arise from changes in poverty status and the provision of family planning-related reproductive health services, affect MMM. A review of the literature suggests a clear perception that higher rates of fertility have a negative impact on maternal health. For example, Kaufman (2005) concludes that despite declining access to government sponsored health care over the past 20 years, China's rigid population policy has led to an overall improvement in women's health by reducing pregnancies and the risk of childbearing. These perceptions and persuasive macro-level correlations notwithstanding, the literature on the impact of high fertility on MMM is both sparse and inconclusive. Much of this literature is focused on the identification of a condition known as maternal depletion, or the situation that occurs when a mother's health is compromised by the stress and strain of repeated childbearing.

Earlier studies found varying relationships between parity, or the number of delivered children, and health outcomes. For example, Trussel and Pebley (1984) using the Malaysian Family Life Survey, found that if the fifth or higher order births were eliminated, maternal mortality would fall by 4 per cent. A study from India has similarly found that 24 per cent of the declining maternal mortality rate that occurred between 1972–1976 and 1982–1986 was attributable to the declining birth rate (Bhat *et al.*, 1995).

A similar strain of the literature focuses more specifically on the role of family planning services in averting maternal deaths. Winikoff and Sullivan (1987) use data sets from Bangladesh, Nigeria, Sweden and the United States to argue that a strategy focused on general fertility reduction, including abortion services and family planning for high risk groups, might reduce maternal mortality by 50 per cent in developing countries. They also stress the importance of better obstetric facilities and care for pregnant women. Another study from Bangladesh and Egypt makes the case for focusing greater attention on promoting family planning, rather

than improving obstetric facilities as a means of reducing maternal mortality (Fortney, 1987).

These and similar studies are limited by the fact that they did not treat parity as an endogenous choice variable. A good example of addressing this weakness is the paper by Higgins and Alderman (1992). In order to account for the correlation of parity with unobserved preferences for maternal and child health as well as health endowments of the mother, these authors make use of instrumental variable techniques. Using body mass index (BMI) as a measure of nutritional status they found a positive effect of parity on nutritional status in OLS regressions, but a significant negative effect after instrumenting. They also found after including parity in the models that the magnitude of coefficients on the education variables shrank by 60 per cent, suggesting that much of the apparent ameliorative effect of education on women's nutrition operates through reduced fertility.

Merchant (1994) has hypothesised that the inconsistent evidence of maternal depletion in earlier research is related to poor measurement of the mother's nutritional status throughout the various stages of the reproductive cycle, and equally poor measures of reproductive stress. With regard to the latter, researchers often use parity as a measure of reproductive burden, but this masks important factors such as time between pregnancies and time allocations to physically demanding versus more sedentary activities during recuperative periods. Likewise, the use of BMI as a measure of nutrient availability during a women's reproductive cycle does not accurately reflect nutritional status, nor does it account for the fact that a woman's weight may vary for a variety of reasons, ranging from water balance to her own antenatal experience, that condition her propensity to accumulate body fat. In support of Merchant's hypothesis, research by Conde-Agudelo and Belizan (2000) in Latin America and the Caribbean on the impact of interpregnancy interval on MMM found that after adjusting for confounding factors, short intervals significantly increased the risk of maternal death and the following morbidities: Third trimester bleeding, premature rupture of membranes, puerperal endometritis and anaemia.¹⁰ Although it is likely that poverty status is negatively associated with the length of interpregnancy intervals, more research needs to be conducted to determine whether this is indeed the case in sub-Saharan Africa.

Assuming that maternal depletion is in fact a persistent phenomenon, the next question is, why do couples reproduce with such frequency that it compromises maternal health? One answer may be found in terms of the lack of access to information and related reproductive health services, contributing to the discordance between desired and actual fertility. The answer to this question may be more complex, however, and follow from behaviours that are not fully consistent with the standard collective model of household decision making and rationality. Observed maternal health outcomes suggest that adult preferences within the household are not uniform, and that the relatively weak bargaining power of women in poor households leads to fertility decisions that are not in their best interest. This

is particularly true of younger brides who are at greatest risk for pregnancy-related complications, but are under the most intense pressure to reproduce (Nour, 2006). Ultimately, conflicting preferences between couples for additional children has the potential to severely compromise the health of both mother and child. For example, Magadi *et al.* (2000) found that use of antenatal care was infrequent for unwanted or mistimed pregnancies, and the WHO (1997) reports that unsafe abortions account for 17 per cent of maternal deaths worldwide.

In order to explore these issues further, research using intrahousehold bargaining models is necessary to tease out power structures within the household that influence maternal health outcomes. The existence of maternal depletion also suggests that there are market failures in the provision of objective information on contraception and family planning services. Contraception may be an effective means of increasing the birth intervals that lead to maternal depletion as well as empowering women to take more control of their reproductive destiny. However, public policy aimed at increasing contraceptive use will certainly benefit from economic research on the most cost-effective means of providing information and services to the poor.

Nutrient Intake, Infectious Disease and the Living Environment

It is widely recognised that proper nutrition is fundamental to the production of good health. Not only do nutrients make proper growth and biological development possible, they allow the body to function properly and ward off disease throughout the life cycle. Adequate nutrient intake is also essential for desirable pregnancy outcomes, as well as successful lactation.

The role of nutrients during early child development is especially critical, since deficiencies during this time will lead to smaller body size and greater susceptibility to disease in adulthood. Women with past histories of poor nutrient intake causing short stature are more likely to face complications in pregnancy, such as obstructed labour, and to produce low birth weight babies (Pojda and Kelly, 2000). Therefore, the consequences of poor nutrition are both long term and intergenerational.

Malnutrition during pregnancy is also a significant risk factor for MMM and poor infant health. Poor nutrition during conception and lactation, low gestational weight gain, and inadequate micronutrient consumption during pregnancy are significantly associated with low birth weight and infant mortality, as well as maternal complications such as anaemia and haemorrhage (FANTA, 2006).

Equation 3 provides a functional representation of nutrient production. It corresponds to an underlying process in which women (the typical preparers of food) extract nutrients from purchased and home grown food using their knowledge, available non-food inputs, and the characteristics of their dwelling, such as food storage and preparation areas. Poverty status can affect the production of nutrients through all of the inputs in the nutrient production function. Specifically, poor women have lower educational attainment, substandard food

preparation and storage facilities, and a limited ability to purchase or grow food for consumption. Therefore, some of the effects of poverty on nutrient production occur through lower purchasing power, while others are mediated through lower asset and human capital accumulation. As an example of the latter, Wolfe and Behrman (1987) find that the children of women with more schooling have higher nutrient intakes, even after controlling for unobserved common childhood background. In order to empirically identify these effects of poverty on nutrition one can, in accordance with Equation 12, estimate individual demands for food and other inputs to nutrient production as a function of prices, incomes, and exogenous endowments and tastes. To determine the overall impact of poverty on nutrient intakes, these individual demands can be substituted into Equation 3 to generate the derived demand for nutrients.

Much of the research on the relationship between poverty and nutrition has taken place in the context of reduced form derived demands, involving the estimation of income or expenditure elasticities of calories and nutrient intake. Reviews of the empirical literature on these elasticities can be found in Behrman and Deolalikar (1988) and Strauss and Thomas (1995). Empirical estimates tend to vary widely (ranging from 0.01 to 1.18 for total calories), in part because of differences in methodology and the failure to account for endogeneity and measurement error. Elasticity estimates based on the indirect computation of calorie elasticities from food demand systems tend to be higher than those computed directly from commodity-specific consumption data. In addition, elasticities based on current income tend to be lower than those based on expenditures, possibly as a result of greater measurement error in the former. Both measures are susceptible to endogeneity due to the reciprocal impact of nutrient intake on productivity and wages. Studies also suggest that the calorie-income relationship is highly non-linear, which complicated the interpretation of earlier estimates based on more restrictive linear specifications. Non-parametric estimates of the calorie/nutrient-income relationship suggest that nutrient and calorie intake is moderately responsive to increases in income among the poor, but as income levels rise this responsiveness decreases and nutrient intakes plateau, with further increases in income having no effect on intakes.

While there is a large literature on the nutrient-income relationship at the household level, there is a paucity of research on this relationship at the individual level, and particularly among women during their reproductive cycle. The distribution of food and nutrients within households is clearly an area where some researchers have suggested that the common preference model of household decision making is inappropriate, or at least of limited value. The concern is threefold. First, children may be discriminated against in terms of the allocation of food and nutrients. Second, young girls are especially vulnerable if there is a gender bias within the household that adversely affects girls, and thus their future productivity and reproductive experience. And third, women of reproductive age may be discriminated against in favour of their male partners.

The literature provides a substantial amount of evidence on unequal intrahousehold food distribution in the context of allocations to children. Several papers indicate a greater proportion of income under the control of women is spent on children (e.g., Hoddinott and Haddad, 1995; Sahn and Gerstle, 2004; Lundberg *et al.*, 1997). Likewise, there is a considerable amount of evidence that gender preferences exist for male versus female children among men, but that this is not the case for women (e.g., Thomas, 1990; Sahn and Stifel, 2000, 2002). While these findings have clear and important implications, the latitude and options for public policy to address within-household decision making processes might be quite limited (Alderman *et al.*, 1997).

Because women have more control over food preparation than men, it stands to reason that they may be able to mitigate distributional disparities in food between themselves and other adult household members. For example, Pitt *et al.* (1990) find that the variance in calorie consumption between men and women in Bangladesh seems to reflect perceptions of male participation in activities where productivity is sensitive to health status.¹¹ They also find that households are averse to inequality in the distribution of calories, suggesting that models of household behaviour should incorporate preferences for distributional equality. Thus, differences in intrahousehold food allocation among adults are found to exist, but they do not necessarily reflect a gender bias against women in this case.

Among poor agricultural households, the ability to achieve recommended levels of nutrient intake is not constant, but varies throughout the year with the season and agricultural production process. Along these lines, Behrman *et al.* (1997) have demonstrated that calorie intake is moderately responsive to increases in wages during the planting stage, but when food becomes plentiful during the harvest stage, increases in income have little impact on calorie consumption.¹² In a case study from The Gambia, Poskitt (1995) finds that women expend the most energy during the planting stage and subsequent rainy season when food is the least plentiful. The implication is that women who become pregnant or are lactating during these periods will have much more difficulty maintaining adequate levels of nutrients or reaching appropriate gestational weights. In Malawi, for example, there was a 2 kg difference between the weights of lactating women during the pre-harvest and post-harvest periods (Ross and Habicht, 1995).

We may therefore expect that poor mothers in sub-Saharan Africa are having trouble meeting nutrient intake requirements, even when they are not pregnant, and particularly during the planting and subsequent rainy seasons. Moreover, the added nutritional requirements associated with pregnancy and lactation exacerbates pre-existing conditions and lead to new indications of diet-related disease. Micronutrient deficiencies in vitamin A, zinc, folate, calcium, iodine and iron have all been linked to MMM throughout the developing world (UNSCN, 2004). These deficiencies often lead to diseases, such as anaemia, that are risk factors for MMM in and of themselves and make women more susceptible to other pregnancy-related complications.¹³ Based on a meta-analysis of eight countries in Africa, anaemia was

found to cause 3.7 per cent of maternal deaths. Furthermore, having anaemia makes women less likely to survive bleeding (haemorrhage) during or after pregnancy, which is the leading cause of maternal death in Africa, accounting for 33.9 per cent of all deaths (Khan *et al.*, 2006).

The significant burden of anaemia among the poor in sub-Saharan Africa is in large part due to the high prevalence of infectious diseases such as malaria, hookworm and HIV/AIDS. Indeed, between 200,000 and 500,000 pregnant women in sub-Saharan Africa develop severe anaemia as a result of malaria (Steketee *et al.*, 2001). Malaria is also associated with increased risk of stillbirths and spontaneous abortions, and in highly endemic areas is more likely to infect women in the first pregnancy, who are at greater risk for other complications (Miaffo *et al.*, 2004; Garner and Gulmezoglu, 2001). There are several places where the incidence of infectious diseases interfaces with our economic model of MMM. Clearly, the treatment of these diseases is highly dependent on access to high quality medical care and preventative services, which as demonstrated above is adversely affected by high poverty status. Nonetheless, these diseases differ in the sense that their contraction is very much due to a woman's living environment.¹⁴

One constraint faced by the poor is the limited ability to purchase suitable housing in a sanitary environment. Often, the poor are forced to live in marginal areas near pools of collected water, and yet cannot afford to screen their dwellings adequately, both of which make them more susceptible to mosquito transmitted malaria infections. The living environment often does not include access to clean water, or suitable land to separate livestock from the general living area, which increases exposure to parasitic infections such as hookworm (another leading cause of anaemia).¹⁵ In either case, the financial constraints on poor families result in a less desirable living environment, putting them at greater risk of contracting communicable diseases having adverse consequences for maternal health.

Time Allocation Decisions

How women spend their time and how much time they have for rest and health maintenance activities is an important, if not frequently overlooked, determinant of health status. As women progress in their pregnancies they require more time away from their traditional household production tasks and labour market activities. To the extent that poor women are unable to reduce the amount of time spent working, they are less likely to achieve the proper gestational weight or seek appropriate levels of antenatal care. A number of characteristics of poor households suggest pregnant women are constrained in the amount of time they allocate to leisure (rest and health maintenance). First of all, the household may depend on their external labour market earnings or time supplied to agricultural production in order to purchase basic subsistence commodities. Second, poor households tend to have high fertility, so that the amount of time a women needs to devote to home production and caregiving is high, and will generally increase with every birth. These burdens of child care are especially acute when birth intervals are short and

thus the average age of children in the household is low. Finally, there often exists a trade-off between leisure consumption and proper nutrient intake. To the extent that women have specialised skills or culturally determined roles in meal preparation, for which there are not good substitutes within the household, a poor woman's ability to reduce time spent preparing meals may be limited, and doing so could potentially harm the nutritional status of both herself and her children.

There is very little empirical economic research on time allocations as they relate to health, and none that we are aware of specifically for MMM. A number of researchers have demonstrated, within the context of household agricultural production and commodity demand models that, the assumption of weak separability between the demand for leisure (or labour supply) and other goods does not hold. Furthermore, jointly modelling labour supply and food consumption decisions indicates a measurable impact on demand elasticities (Blundell and Walker, 1982; Swafford and Whitney, 1987; Browning and Meghir, 1991; Alderman and Sahn, 1993). In a study of time allocation for a small number of Rwandan households, Bhargava (1997) finds that men and women with low energy intakes spend more time resting and sleeping in order to maintain body mass. Estimates from his empirical model also suggest that women substitute between household and agriculture, with children increasing their contributions to the former when they become old enough. One would assume that the same trade-offs that apply to food consumption; leisure and the supply of labour to agricultural production also apply to the production of health and nutrition.

There are very few studies that investigate the impact of labour supply decisions on health seeking behaviour in a developing country context. One study, by Meyerhoefer *et al.* (2007), models labour supply decisions jointly with the demand for health care. The study develops a measure of leisure that includes time spent on health maintenance activities, but excludes all other types of home production and labour supply. By estimating a joint model of commodity, leisure and health care demand, they find that health care and leisure are complements, and that changes in individuals' value of time (shadow wage) have a differential effect on the demand for health care providers in accordance with their travel distance to households; increases in time valuations decrease provider demand proportionally more for distant providers. The complementarity of health care and leisure also suggests that individuals increase their leisure consumption when sick in order to travel to providers and implement prescriptions for rest and recovery. In the context of maternal health services, this implies that as women's time in home production and labour supply activities becomes relatively more valuable, they are less likely to seek appropriate levels of antenatal care or spend time recovering from a recent pregnancy. The situation is compounded by the fact that many poor women live in isolated rural areas far from hospitals with modern obstetric technologies. Therefore, both the high travel costs associated with care at high quality providers, and the cross price effects of user fees for medical care on leisure demand, work to limit health seeking behaviour by the poor.

The issue of time allocations in the context of maternal health clearly needs more specific investigation. Critical issues include the ability of other household members to substitute their labour for that of pregnant or lactating women in household and agricultural production activities, and how such substitutability varies with production season,¹⁶ this is clearly linked to issues of family size and age composition of the pregnant woman's household. Having multiple young children may place an additional strain on women if no one can substitute for caregiving tasks, but as children grow older they may be able to substitute for women's time in domestic tasks during pregnancy and following delivery.

Impact of Maternal Health on Poverty

Beyond considering the impact of poverty on maternal morbidity and mortality, and related issues such as demand for children, health care and food, there is another important dimension of the maternal health/poverty nexus: the relationship between maternal health outcomes and the subsequent wellbeing of the household as mediated through household income and home production activities. As we noted in our discussion of the neo-classical model, health status, or accumulated health stock, is an input into several equations that measure the productivity of household members and determines their ability to generate household income and engage in home production activities, particularly the care of children.

Many women in Africa are important economic providers for their households, both during and after pregnancy. While the share of women engaged in the formal wage sector remains small (Sahn *et al.*, 1997), women are still actively engaged in the labour market as own-account and self-employed workers in agriculture and small-scale enterprises. In all these cases, adverse health events reduce both the number of hours they can supply to the labour market and the productivity of their work. There is the additional concern that reductions in the mother's labour supply and earnings as a result of adverse health shocks may mean that child labour will be substituted, lowering children's educational attainment and future productivity and resulting in general allocation inefficiency.

The empirical evidence on the impact of health shocks that cause MMM on earnings is sparse, and clearly an area ripe for further inquiry. Indeed, there is a convincing literature that the health of women (and men) has important effects on productivity, both within and outside of agriculture. The paper by Strauss and Thomas (1998) remains the seminal review article in this area. It reviews the correlations between health and labour market outcomes, and addresses the methodological challenges to the generation of non-experimental evidence on the causal impacts among health, labour supply and productivity.

Most of the literature on the relationships among health, labour supply and earnings focuses on nutritional status, and the preponderance of the studies are non-experimental in nature. This literature includes the impact on both agricultural wages rates and own-farm output, as well as earnings outside of agriculture, in both

the wage and the non-wage sectors. For example, the work by Haddad and Bouis (1991) indicates that there is a positive relationship between nutrition and the wages of agricultural workers, as well as production of own-account producers. Interestingly, however, these authors conclude that the nutrition effects, particularly as manifested in better adult height, are primarily a reflection of early childhood (presumably including antenatal) factors, rather than recent-term nutrient intake. Thus, the authors implicitly highlight the role of the reproductive health of mothers, and inter-generation transmission of human capital.

A series of other papers has examined the impact of nutrition on farms output and wages, such as Strauss's (1986) work in Sierra Leone and Deolalikar's (1988) in India. These papers all rely on non-experimental evidence. Similar studies examine the impact of calories and nutrition on urban wage and non-wage workers, such as those by Strauss and Thomas in Brazil (1997) and Glick and Sahn in Conakry, Guinea (1998). All of this work contrasts with the nutrition and biomedical literature in which there are several examples of efforts to examine the labour market effects of nutritional supplementation using randomised controls. For example, Wolgemuth *et al.* (1982) report on a study showing that road workers in Kenya witness small productivity gains as a result of energy supplementation; Basta *et al.* (1979) report on the impact of supplementing rubber tree tappers and weeders in Indonesia with iron; and Imminck *et al.* (1981) and Viteri *et al.* (1981) examine the impact of calorie supplementation on sugarcane workers in Guatemala.

While the results of the latter literature are mixed, it is also not focused on women during their reproductive period, nor does it explicitly link shocks and adverse events to poor health, and subsequent deleterious labour market outcomes. This neglect in the literature is important for a number of reasons. Perhaps most prominent is that there is a failure to understand and appreciate the potentially substantial benefits in terms of higher productivity and economic growth that accrue from public investment in the health sector, and particularly in meeting the needs of women during the reproductive period. It is also worth noting that these returns are likely to be greatest among the poor, who are particularly vulnerable to the negative consequences of poor health on their ability to work and provide for their families' basic economic needs.

Beyond the impact of health on labour market activities, there is a related concern that severe acute maternal morbidity (SAMM) adversely affects home production and caring for children. Indeed, there is every reason to expect that the same type of deleterious effect of poor maternal health and mortality on work performance outside the household will occur with respect to traditional household roles and responsibilities. That is, mothers who experience SAMM are also less productive at home and less able to take care of their newborn or pre-existing children. For example, the inability to breastfeed may have negative consequences for child nutrition. Mothers may also be less likely to provide the appropriate care in terms of various forms of nurturing, food preparation, ensuring a safe and sanitary living environment, or even taking the child for appropriate postnatal care. As intimated

earlier, loss of productivity in this sphere is particularly worrisome as it goes beyond the contemporaneous loss of income and earnings, but may adversely affect outcomes later in life and reduce the future productivity of children, thus creating an inter-generational poverty trap.

Research in this area is far more limited than that in the labour market literature, although clearly the two are inextricably linked. This point is made, for example, in a paper by Bhargava (1997) reporting that the low incomes and high prices that reduce nutrient intake contributed to additional time resting and sleeping, both at the expense of household and agricultural work. What is particularly interesting, however, is that among women, there appears to be a substitution in favour of them working in agriculture, while work in the home is relegated to other members. This could imply a compromise in terms of caring for children, especially if this pattern occurs during the period of lactation and weaning.

Empirical Modelling

Identifying the structural relationships between poverty and maternal morbidity and mortality generally requires the use of complex econometric and statistical methods. The same is true of studies measuring the effectiveness of public health interventions or poverty reduction strategies. This is because most of the data used for such purposes are observational in nature, and not produced under the protocol of a randomised controlled experiment. Even in the case of the latter, statistical techniques must be employed to quantify the effect of a given treatment. Because economic or policy modelling using observational data is both more common and more challenging from an econometric standpoint, we will focus on these techniques. However, we will also discuss methods commonly applied to natural experiments (instances when a natural control group arises after the implementation of a policy change or intervention). Since many of the techniques discussed below are covered in far greater detail in standard econometrics texts, we do not provide references in many cases. Examples of widely used references include Wooldridge (2002) and Greene (2003).

Structural Equation Modelling and Reduced Forms

Often researchers will be interested in modelling several of the structural relationships presented earlier in order to forecast the impact of an economic or policy change on a particular outcome. For example, one might be interested in how higher wages brought about by a wage subsidy programme affect the demand for postnatal care. This may be an important policy question in cases where mothers return to wage labour shortly after bearing children. The framework presented above suggests the demand for medical care is a function of wages, but that wages depend on an individual's health status, and may therefore be contemporaneously correlated to the consumption of medical services. Empirically, the relationship between the demand for postnatal care and mother's wage can be expressed as:

$$M_i = \beta'_1 X_i + \gamma'_1 X_{1i} + \delta_i P_i^L + \varepsilon_{1i} \quad (13)$$

$$M_i = \beta'_2 X_i + \gamma'_2 X_{2i} + \delta_i M_i + \varepsilon_{2i} \quad (14)$$

where X denotes a vector of variables that both affect the demand for postnatal care and determine wage rates, Z_1 is a vector of variables that affect the demand for medical care but are uncorrelated with wages, and the variables in Z_2 affect wages but not medical care.

As long as Z_1 and Z_2 both contain at least one column, then the system of equations in (13) and (14) is a fully identified simultaneous system of equations, where Z_1 and Z_2 contain the identifying instruments. The problem in most empirical work is either that such instruments are unavailable or that the simultaneous relationship between medical care and wages is ignored, and each equation is estimated separately using ordinary least squares (OLS). In the case of the latter, the estimated β parameters will be biased and inconsistent. To see this, note that if the wage rate is not included on the right-hand side in Equation 13, it will become part of the error term. Since P^L and X are correlated in accordance with Equation 14, orthogonality between the error term and regressors does not hold and the parameter estimates are biased.

If instruments are available to fully identify the simultaneous system, the choice of estimator involves a trade-off between the potential for propagating model misspecification errors and greater statistical precision. In the typical case where ε_1 and ε_2 are assumed to be correlated, estimation techniques that account for this correlation will be the most efficient. Provided that the errors are also normally distributed, the efficient estimator for the simultaneous system is full information maximum likelihood (FIML). However, departures of the error distribution from normality will result in biased estimates, so it is common to instead use three-stage least squares to estimate (3SLS) the system. Single-equation estimators are also available that are still consistent, but less efficient than FIML and 3SLS because they do not account for the correlation of the errors in estimation. Again, if the errors are normally distributed the most efficient estimator in this class is limited information maximum likelihood (LIML) and a consistent estimator that does not require a distribution assumption is two-stage least squares (2SLS). While the single-equation estimators are less efficient than the systems estimators, they do have the advantage that specification errors in one equation will not be propagated throughout the entire system.

In some cases, one may be able to assume that current wages are not a function of current consumption of medical services. There are several reasons why this might be the case. For one, medical services are rendered for a condition that does not significantly affect productivity. Other possibilities are that wages are sticky in the current period, or that the impact of medical services on productivity occurs primarily over the long run. However, it may still be the case that the wage rate is endogenous in a demand equation for postnatal care because of the omission of one

or several important variables that affect medical care and productivity (information on educational attainment, for example). We can represent this situation by setting $\delta_2 = 0$ in Equation 14. Indeed this is the common case where one suspects that the key policy variable (P^L) is potentially correlated with important unobservable factors in the error term. Again, in order to obtain consistent estimates of the structural parameters using 2SLS, one must have instruments that are significantly correlated with the wage rate, but orthogonal to postnatal care and the error term.¹⁷

An alternative to structural equation modelling and the separate identification of the relationships underlying an economic or behavioural process, is the specification and estimation of a reduced form model. For example, one could substitute (14) into (13) and obtain a new expression in which the demand for postnatal care is a function of all the exogenous variables in the model and combinations of the structural parameters. This is a common approach when instruments Z_1 and Z_2 are not available. Without instruments, however, there is no way to separately identify the reduced form from the structural parameters. Nonetheless, the reduced form parameters can be estimated consistently using OLS, and this may provide all the information needed to conduct policy analysis. If we are only interested in the overall effect of a change in an exogenous regressor on the demand for postnatal care, then reduced form estimates would be the appropriate ones for policy analysis as well as the easiest to obtain. Some researchers prefer to estimate hybrid models in which some relationships are modelled structurally while others are incorporated in a reduced form manner. The choice of which relationships to model structurally is typically based on the availability of data. A good example of the construction and estimation of a quasi-reduced form model is Glick and Sahn's 1998 paper on maternal labour supply and nutrition in West Africa.

Panel Data and Quasi-Experimental Techniques

There are many situations in which panel data can be used to obtain the unbiased impact of a potentially endogenous variable on the outcome variable of interest. In panel data sets information on respondents is collected during several time periods, thereby providing a means for accounting for unobserved confounding factors, or *unobserved heterogeneity*. For example, consider a modified version of Equation 13 where data have been collected in time periods $t=1, \dots, T$

$$M_{it} = \beta_1' X_{it} + \delta_1 P_{it}^L + c_i + \varepsilon_{1it} \quad (15)$$

In this specification c_i represents an unobserved time-invariant factor. If the factor c_i is orthogonal to the wage rate, then OLS still provides a consistent estimate of δ_1 the parameter of interest. However, it is possible to improve the statistical precision of the OLS estimates by using a *random effects* panel data estimator, which explicitly accounts for the presence of c_i in the error term.

The more common situation that arises is that the unobserved factor is correlated with the wage rate, so that both OLS and random effects estimates of δ_1 are biased.

In the current example, this would be the case if c_i were used to denote an individual's unobserved health endowment. Intuitively, the inclusion of a dummy variable for every individual in the estimating equation would solve the unobserved factor problem by explicitly controlling for all unobserved individual-specific, but time-invariant effects. Computationally, such an approach would likely be infeasible because of the large number of individuals in the data set relative to the typically short time dimension of most panel data. Fortunately, there exists a *fixed effects* panel data estimator that is mathematically equivalent to the inclusion of a dummy variable for every individual, but is implemented in a computationally feasible way (by putting all variables in deviations from their individual specific means). In the case where there are only two time periods in the panel, the fixed effects estimator is equivalent to a model in which all the variables have been first-differenced. Since the unobserved factor c_i is the same in both time periods, it will clearly drop out of a differenced model, solving the omitted variables problem.

When using the fixed effects estimator to control for potentially confounding unobservables it is important to keep in mind that this method will not mitigate endogeneity generated by omitted variables that are not fixed over time. More general panel data specifications are available that can be used to capture some dynamic effects, but they are more difficult to implement than standard fixed effects estimators. Building on the previous work of Chamberlain (1980), Jakubson (1991) implemented a *correlated random effects* estimator where the relationship between the outcome variable and the unobserved individual-specific effect was allowed to vary over time (such that c_i is replaced by $\rho_t c_i$ in Equation 15). As is the case with conventional random effects models, this model requires the assumption that c_i follows a specific (usually normal) distribution. More recently, unobserved factor models have developed that do not require such a distributional assumption. Rather, they use non-parametric techniques to approximate the distribution of c_i . These *discrete factor* models can also be applied to panel data to control for individual heterogeneity (Mroz, 1999).

While panel data can be used to address a wide range of questions and to mitigate unobserved variables biases, they are expensive to collect and often not available. A popular alternative to panel models is the *difference-in-differences* (DID) model, which can also be used to control for unobservables using repeated cross sections of data sampled from the same underlying population. These models are commonly applied to programme evaluations or policy analysis when the sample can be divided into logical treatment and control groups.

Suppose, for example, that an outside agency funds a set number of free antenatal visits to obstetricians for all pregnant women, but offers this programme only in one region of the country, region A. Inevitably, some pregnant women in region A will participate in the programme and others will not. Among those individuals eligible for the programme, the participants are likely to be different from the non-participants in important, but observationally unobservable ways. Therefore, a comparison of maternal and child health outcomes for participants and non-

participants will reflect, in part, the baseline differences in the participating population in addition to the effect of the free medical care. However, if individuals in an adjacent region, region B, were very similar to those in region A in both observable and unobservable dimensions, then these individuals who were not eligible for the programme could serve as a control group.

Implementing the DID model requires pooling two cross sections of data from both regions: One collected before the antenatal care programme is put in place, and another collected after it takes effect. The empirical formulation of the DID model is as follows:

$$y_i = \beta'X_i + \delta_1 d2_i + \delta_2 dA_i + \delta_3 d2 \cdot dA + \varepsilon_i \quad (16)$$

where y_i is the outcome of interest (maternal health), X_i is a vector of control variables, $d2_i$ is a dummy variable indicating the second (post-intervention) time period, and dA_i is a dummy variable indicating that the pregnant woman lived in region A and was therefore eligible to receive free antenatal care. Under this formulation, $d2_i$ is used to control for aggregate differences that affect maternal health in the same way for pregnant women in both regions, while dA_i captures otherwise unobserved difference between the two regions, one of which is the treatment group (A) and the other is the control group (B). The coefficient δ_3 on the interaction term measures the effect of the antenatal care programme on maternal health. To see this, note that can be expressed as a function of the conditional mean of the outcome variable as follows:

$$\hat{\delta}_3 = (\bar{y}_{A,2} | X_{A,2} - \bar{y}_{A,1} | X_{A,1}) - (\bar{y}_{B,2} | X_{B,2} - \bar{y}_{B,1} | X_{B,1}) \quad (17)$$

The differencing of the conditional mean within region essentially nets out any aggregate factors that changed between the pre- and post-intervention period that might affect maternal health. After these unobservable confounding factors have been differenced away, the difference between the within-region differences is attributable to the antenatal care programme.

Clearly, the DID framework requires that the treatment and control groups be as similar as possible in order to generate valid estimates of the programme effect. In addition, while aggregate observables are differenced away, the framework does not allow one to control for individual-specific heterogeneity. Rather, it is assumed that idiosyncratic factors are distributed in such a way that they do not result in any systematic difference between the conditional means of the outcome variable in each region.

The DID approach is sometimes referred to as a *quasi-experimental* method because it attempts to replicate the design of a randomised controlled trial (RET) using observation data by specifying a treatment and control group and accounting for aggregate time-varying confounding factors. Another method in this category is referred to as a *regression-discontinuity design* (RDD). The RDD estimator can be applied in situations in which the right-hand side variable of interest is potentially

endogenous, but there is some external process, often a rule or regulation, that generates a discontinuity in the level of that variable. This rule can then be used as instrument for the endogenous regressor because it causes variation in the regressor beyond the control of the observational unit. Furthermore, the fact that identification results from a discontinuous or non-monotonic relationship allows one to control for a variety of smooth relationships between other regressors and the dependent variable. The classic example of an RDD is Angrist and Lavy's (1999) use of Maimonides' rule in the Israeli public school system. Maimonides' rule limits the maximum class in each grade level to 40 pupils. Therefore, a class with a projected enrolment of 41 pupils would be split into two classes with 20 and 21 students, thereby generating a discontinuity in the relationship between grade enrolment and class size. Using an instrumental variables type estimator, the authors are able to use this rule to identify the effect of class size on academic performance.

Both the DID and the RDD are particularly useful in the exploitation of *natural experiments* for policy analysis. This term refers to instances in which some exogenous change in the environment, whether it be the passage of a law or regulation only affecting certain groups or a natural event altering the economic situation of some individuals, leads to clear and valid treatment and control groups. While the exogenous change did not occur as part of a controlled experiment, it is generated in such a way that the individuals falling into the treatment and control groups do not exhibit any systematic differences. Of course, one need not rely on natural experiments if they have sufficient resources to conduct an actual randomised experiment, or RCT. While RCTs have the substantial advantage that nearly all confounding factors can be randomised away (which greatly simplifies data analysis), they suffer from a number of disadvantages. RCTs are expensive, they are targeted towards the investigation of a specific policy question and may have little utility in answering other questions, and they often do not reflect real-world scenarios. Nonetheless, in the biomedical field the RCT is still viewed as the "gold standard" in the analysis of treatment effects.

Selectivity Models

Selectivity models are commonly employed in the literature on programme evaluation in order to generalise empirical findings for programme participants to the entire population. For example, a government health agency may administer a family planning programme that disseminates information on different family planning methods and provides access to birth control devices. Using data from the programme, one could compare the effectiveness of different methods in limiting fertility. These results are not necessarily transferable to the general population of sexually active adults, however, because the individuals who decide to participate in the programme may be different from those in the general population in ways that influence the comparative effectiveness of the methods. If there were a representative data sample that contained information on those who participated in

the programme as well as others living in the same area who did not, a selectivity, or *sample selection model*, could be used to determine the comparative effectiveness of the family planning measures while correcting for the selection effect among programme participants.

The empirical specification for a sample selection model is based on the following underlying latent structure:

$$\tilde{y}_{1i} = \beta_1' X_{1i} + \varepsilon_{1i} \quad (18)$$

$$\tilde{y}_{2i} = \beta_2' X_{2i} + \varepsilon_{2i} \quad (19)$$

where $\varepsilon = (\varepsilon_{1i}, \varepsilon_{2i})' \sim i.i.d.N(0, \Sigma)$, $\Sigma = \{\sigma_{ij}\}$. Equation 18 captures the propensity to participate in the programme, while (19) describes the outcome variable for the participating population. Therefore, the observed data maps to the latent model as follows:

$$y_{1i} = 1 \quad \text{if } \hat{y}_{1i} > 0; \quad \text{otherwise} \quad (20)$$

$$y_{2i} = \tilde{y}_{2i} \quad \text{if } y_{1i} = 1; \quad \text{not observed otherwise} \quad (21)$$

The first equation in the system is estimated using a probit specification in which the dependent variable denotes programme participation and the dependent variables are factors thought to be correlated with the likelihood of participation. The second equation is estimated on only those individuals who participated in the programme, and the dependent variable is the outcome of interest (the fertility rate in our example). Because of the correlation between the error terms in (18) and (19), separate estimation of the outcome equation on the programme participants will not yield unbiased parameter estimates. Both equations can be estimated efficiently using joint maximum likelihood (ML) estimation, but it is important to note that the joint likelihood function for the two equations is not globally concave. Therefore, most software packages that perform joint estimation first condition the likelihood on the correlation coefficient between the two error terms then perform a grid search on this parameter and iterate to convergence.

In the past when joint maximum likelihood estimation of the sample selection model was computationally expensive, a popular alternative was the use of a consistent *two-step approach*. This approach is still widely used today to obtain starting values for the ML procedure or in cases where the available software package does not have a pre-programmed sample selection routine. In the first step of the two-step approach, a probit model is estimated on the full sample and used to construct an inverse Mills' ratio (or selection correction term), having the following form:

$$\frac{\phi(\hat{\beta}_1' X_{1i})}{\Phi(\hat{\beta}_1' X_{1i})}$$

This inverse Mills' ratio is then added to the second equation, which is estimated using OLS. When interpreting the estimation results from the two-step approach, analysts should be mindful of the fact that the non-concave joint likelihood function has been found to frequently exhibit a local maximum near zero, so findings of "no selection" should be treated with some scepticism. Finally, if the two-step approach is used, the standard errors generated by OLS will not be correct because of their failure to account for the stochastic nature of the inverse Mills' ratio. The delta method can be used to correct the standard errors.¹⁸

A fundamental issue in both joint ML and two-step estimation is the separate identification of the first and second stages of the model. In practice, the variables thought to influence the probability of participation are the same ones that affect outcomes among participants. As a result, X_1 and X_2 will share many common elements, with robust identification of the model requiring at least one variable in the former (which is strongly and significantly related to participation) that is not in the latter. Unfortunately, it is often difficult to identify theoretically plausible exclusion restrictions for the second stage. Although the model is technically identified even without exclusions, this identification is achieved purely through functions form. In the two-step approach, this type of identification is made possible by the non linearity of the inverse Mills ratio. However, the variability of the data in many samples is such that the inverse Mills ratio is not highly non linear, and therefore identification is tenuous at best without a valid exclusion restriction.

Because of the difficulty in finding valid exclusion restrictions to identify the sample selection model, some researchers have made use of an alternative specification called the *two-part model* (Jones, 2000). This model shares the same basic set-up as described in equations (18)–(21), with one key difference: The error terms in (18) and (19) are assumed to be uncorrelated. While this may be an unrealistic assumption not well suited to behavioural modelling, supporters of the two-part model claim that it is valid when the main objective is to predict the second-stage outcome variable. Nonetheless, there has been a fair amount of debate about the appropriate use of the two-part model relative to the sample selection model (Hay and Olsen, 1984; Duan *et al.*, 1984). Perhaps the best guidance on choosing between the two comes from a 1987 study by Manning *et al.* Using Monte Carlo techniques, these authors find that the two-part model outperforms more general sample selection models in the common case where an exclusion restriction to empirically identify the first stage is not available. However, the greater generality of the sample selection model suggests it is preferred in cases where a valid exclusion restriction does indeed exist.

Risks, Shocks and Dynamic Models

One of the most interesting findings of the recent surge in qualitative poverty analysis is the emphasis that poor people place on vulnerability when they define their own poverty or concerns over their health. Time and again, the risk of falling into poverty (measured in many possible dimensions) and falling ill receives as

much attention as deprivation itself in conversations with the poor. While people everywhere face risks, these risks are larger for poor, agrarian economies, especially in tropical ecologies. Likewise, they are worse in countries, such as throughout Africa, where the poor have fewer means for dealing with the risks and shocks that they face.

In this regard, it is hard to place enough emphasis on the important gender dimension of vulnerability to shocks. Women, particularly of reproductive age, have risk assessments that differ systematically from men's, emphasising issues of health and violence – often of a sexual nature – far more frequently (Narayan, Narayan-Parker and Walton, 2000; Narayan, Chambers, Shaw and Petesch, 2000; Smith *et al.*, 2001). There is thus a particular need for policy-oriented research that identifies vulnerability in a gender-sensitive fashion that focuses on the vulnerability of women in their reproductive experience and subsequent roles as caregivers. Of particular importance are downside risks associated with negative shocks. While research on poverty dynamics reveals much movement in and out of poverty over time in Africa, downside health risks, especially associated with childbirth and deleterious health-related events, represent the type of shock that contributes to a poverty trap. In other words, a family's ability to fully recover from a maternal death or severe maternal morbidity is often limited, inducing a recurring cycle of crisis and deprivation. This often has an inter-generational aspect, as illness of a mother may force the family to pull children, especially girls, out of school. Hence, it is important to understand, for example, the extent to which child labour acts as a coping mechanism against vulnerability, especially given that it imposes severe costs by reducing future productivity and ensuring that poverty and deprivation is transmitted across generations. Likewise, research on the role of policies to reduce risk and vulnerability, rather than just reacting to the shock itself, is of critical importance.

A focus on notions of vulnerability and risk associated with reproductive health strongly suggest research approaches that employ methods that allow us to focus on dynamics of behaviours and outcomes in response to uncertainty and risk. Outcomes and choices regarding pregnancy and the broad range of factors that contribute to maternal morbidity and mortality, as well as issues related to choices women make in terms of caring for children, are inherently part of a complex dynamic process. Women who are lucky or are more adept at accessing services and opportunities will help protect themselves against the ravages that are often associated with the risks of childbearing. Other less fortunate households suffer shocks, such as unwanted pregnancy, maternal mortality and morbidity, loss of employment, and so forth, with long-term repercussions that send them spiralling downward into greater poverty. Understanding these processes is key to understanding how policies might help the poor to rise out of poverty, and requires data on households' events and circumstances over time.

The most obvious forms of such data are longitudinal and panel surveys, which only very recently have become available for Africa. Examples include the panel

surveys from Ethiopia and Zimbabwe. In panel surveys, households are interviewed at different points in time. Analysis of dynamics using such data for developing countries is new, but rapid progress is being made on methodologies and treatment of specific statistical issues such as measurement error and attrition bias. Panel data of sufficient length allow researchers to make a crucial distinction between chronic and transitory poverty, and the role of maternal and reproductive health in this regard. Furthermore, they allow researchers to control for differences in genetically determined health endowments that affect the decisions of individuals, but are unobservable in most survey data.

Indeed, we know that key determinants of long-term changes in poverty status are likely to include accumulation or dis-accumulation of assets; policy-induced changes in returns on those assets; and shocks, particularly those associated with women's reproductive experiences. In principle, these factors are identifiable from household surveys. Moreover, initial conditions are likely to be important and can also be measured to varying degrees in surveys. These include levels of human, social and physical capital; presence of physical and social infrastructure; access to markets; and access to, demand for and utilisation of services.

Mixed Methods

Analysis of the issues discussed previously inevitably requires some expansion of boundaries between disciplines, and potentially, research strategies that combine quantitative and qualitative methods. There are various models for achieving these objectives, including concepts such as triangulation, in which – to paraphrase Robert Chambers (2001) – qualitative and quantitative researchers engage in their own efforts and subsequently bring them together to compare results. Triangulation checks for similar findings from the different methods. A different model, the idea of sequential mixing (Ravallion, 2001) often involves beginning research programmes with focus groups, unstructured interviews or ethnographies – all of which bring out interesting ideas and perspectives on a particular research theme. A quantitative analyst could then devise hypotheses consistent with these ideas to be tested empirically with data from representative samples. Yet a third model is to insert qualitative methods directly into a quantitative study, and vice-versa.

Researchers at Cornell University's Food and Nutrition Policy Program (CFNPP) have practised these approaches successfully in Africa. We observe that there are several further concrete possibilities for simultaneous mixing of research strategies in the context of this project on reproductive health implemented by the African Economic Research Consortium (AERC). One such example would involve the use of contingent valuation, a method in which the researchers conduct a quantitative-type survey, but with questions more familiar to psychologists than economists. In particular, researchers explore the value of public services, such as family planning services, or institutions to recipients by asking a carefully phrased equivalent of how much is this worth to you? A similar effort at contingent valuation was made in the context of a survey in Tanzania designed to examine health status and service

delivery in Tanzania. One of the objectives of the survey was to understand the factors that influence the demand for health services, particularly the influence of school and clinic quality. We are interested in exploring the use of such methods in our research, particularly when evaluating public goods. Thus, while we would argue strongly that sound empirical and quantitative analysis is the appropriate focus of AERC's initiatives in exploring the reproductive health/economic growth nexus, consideration should be given to incorporating mixed methods and disciplinary perspectives into the research.

Conclusions

As we point out in the introduction, good maternal health is of fundamental importance to Africa's (and the world's) future. Protecting the health of mothers during reproduction safeguards their future contributions to society and ensures the health and productivity of future generations. Compromising the health of mothers or their newborn offspring will do the opposite and have serious negative consequences for their families, communities, and the entire process of economic and social development at the national level.

There is no doubt that poverty and poor reproductive health are inextricably linked, contributing to each other and jointly determined by a set of failed policies and other social and economic conditions that prevail throughout sub-Saharan Africa. In addition, disparities in household incomes and community characteristics within countries undoubtedly explain a large share of the within-country inequality of reproductive health in Africa.

Indeed, there are many ways in which might lead to high MMM. For example, extreme poverty is often associated with limited access to necessary antenatal medical care as well as appropriate medical resources during and after delivery. Furthermore, the lack of access to family planning and reproductive health services may result in a demographic profile, such as young age at first birth and high overall fertility, which increases the reproductive risks to mothers and their offspring. The poor may not have access to fresh water; they may live in substandard dwellings and be at greater risk of contracting malaria or parasitic infections that compromise a woman's immunity during pregnancy.

Clearly, illness or death resulting from childbirth will limit a woman's future productivity in the labour market and earning power, thereby contributing to a cycle of poverty and poor maternal health outcomes. The result is a poverty trap whereby mothers are more likely to die or become ill during or after pregnancy because they are poor, and more likely to be poor in the future as a result of negative health shocks during this period. Likewise, mothers who are sick or die are not able to provide adequate care for their children, thus further contributing to this downward cycle of poor reproductive health outcome and poverty.

In this chapter we have focused on the complexity and multi-faceted nature of the relationship between MMM and poverty. We have also provided a thorough

presentation of a unified theoretical framework and discussed the types of complex empirical models that can capture the linkages and evaluate the range of public policies designed to improve the reproductive health of women. Our goal has thus been to elucidate the substantive and methodological approaches and challenges, and research opportunities for the AERC network in Africa.

Notes

1. The number of deaths per 100,000 pregnancies would be a more comprehensive and precise metric since it includes mortality from unsafe abortions, but incidence of pregnancy is difficult to track.
2. The most common reasons for a near-miss were: Emergency hysterectomy in 42 women (29 per cent); severe hypotension in 40 (27 per cent); and pulmonary oedema in 24 (16 per cent). The most common initiating obstetric conditions were hypertension in 38 women (26 per cent); haemorrhage in 38 (26 per cent); and abortion or puerperal sepsis in 29 (20 per cent). The primary obstetric factors amongst the maternal deaths were: Hypertension (33 per cent); sepsis (27 per cent); and maternal medical diseases (17 per cent) in 10, 8 and 5 women, respectively. Substandard care was identified in 82 cases. Breakdown in the health care administration was identified in 33, and patient-oriented missed opportunities on 34 occasions.
3. According to the WHO (1997), bleeding (haemorrhage) lead to 24 per cent of maternal deaths, and infections, such as sepsis, caused 15 per cent of deaths. The remaining direct causes of maternal mortality were unsafe abortions (13 per cent), eclampsia (12 per cent), obstructed labour (8 per cent), and other direct causes (8 per cent), including ectopic pregnancy, embolism, and anaesthesia-related death. Indirect causes accounted for 20 per cent of deaths. A more recent analysis by Khan *et al.* (2006) based on a subset of countries in Africa, suggests hemorrhage is responsible for 33.9 per cent of deaths, followed by indirect causes (16.7 per cent), sepsis/infections (9.7 per cent), hypertensive disorders (9.1 per cent), and HIV/AIDS (6.2 per cent).
4. Underlying this hypothesis is the supposition that many people are engaged in wage or piece rate labour that is dependent on physical strength, and therefore good health, making it likely that health status directly affects worker productivity.
5. Often total allowable time is defined as 24 hours minus that devoted to sleeping and eating (6–10 hours). In the case where one of the time categories is time spent in health maintenance activities (TiH above), much if not all of the time spent eating and sleeping falls under this category, so that total time is exactly 24 hours.
6. In the above formulation we have not included savings since the model can be treated as a single period model conditional on prior investments in health. We might also assume that any potential savings are invested in farm capital, KH.
7. If recursivity cannot be assumed, then the other exogenous variables will have a direct impact as well, but we will focus primarily on predetermined full income. Note

that this still allows us to consider price effects in the form of wages, which influence labour supply and other time allocation decisions.

8. Raghupathy (1996) actually investigates the impact of education on three different types of maternal health services. While she does find higher utilisation to be correlated with higher levels of education for prenatal care and delivery assistance, she does not find this to be the case for tetanus toxoid inoculations.
9. For a clear and concise presentation of the methods and approach discussed in this section, see Dehn *et al.* (2003) and Devarajan and Reinikka (2004).
10. They also find that very long intervals, greater than 59 months, put women at risk for pre-eclampsia and eclampsia.
11. The implication is that increases in the diversity of labour force opportunities for women would narrow differences in calorie intake relative to men, but increase intake inequalities among women, as those with higher endowments who are more likely to take more physically demanding jobs are reinforced with additional calories.
12. They also find that small productivity effects of calorie consumption during the planting stage are realised during the harvest, suggesting that mechanisms allowing poor households to increase calorie consumption during planting will serve two purposes: reducing malnutrition and increasing farm profits.
13. Approximately 50 per cent of all anaemia is due to iron deficiency (FANTA, 2006).
14. Some infectious diseases are in fact more related to education levels, and access to family planning and other health services than to the living environment. Chief among these are sexually transmitted diseases such as HIV/AIDS.
15. The most common method of hookworm contraction in developing countries is walking shoe-less through soil contaminated with animal faeces.
16. For example, the research by Poskitt (1995) in The Gambia suggests that pregnant women have difficulty maintaining appropriate weight levels during the planting/wet season.
17. While the applied literature is replete with examples of the exactly identified case where only K instruments are used to correct for the endogeneity of K endogenous variables, an often over-looked result from Kinal (1980) states that the m th moment of the 2SLS estimator exists iff $m < \# \text{ of instruments} - \# \text{ of endogenous regressors} + 1$.
18. Note, however, that the uncorrected standard errors are the appropriate ones for testing the null hypothesis of “no sample selection”.

References

- Aassve, A., H. Engelhardt, F. Francavilla, A. Kedir, J. Kim, F. Mealli, L. Mencarini, S. Pudney and A. Fuernkranz-Pskawetz. 2005. “Poverty and fertility in less developed countries: A comparative analysis”. ISER Working Papers No. 2005–13. Institute for

- Social and Economic Research, University of Essex. <http://www.iser.essex.ac.uk/pubs/workpapers/pdf/2005-13.pdf>.
- Ablo, Emmanuel and Ritva Reinikka. 1998. "Do budgets really matter? Evidence from public spending on education and health in Uganda". Policy Research Working Paper No. 1926. Development Research Group, the World Bank, Washington, D.C.
- Ahmed, S. and H. Mosley. 2002. "Simultaneity in the use of maternal-child health care and contraceptives: Evidence from developing countries". *Demography*, 39: 75–93.
- Alderman, H. and D. Sahn. 1993. "Substitution between good and leisure in a developing country". *American Journal of Agricultural Economics*, 75: 875–83.
- Alderman, Harold, Lawrence Haddad and John Hoddinott, eds. 1997. *Intrahousehold Resource Allocation in Developing Countries: Models, Methods, and Policy*. Baltimore and London: Johns Hopkins University Press for the International Food Policy Research Institute.
- Angrist, J. and V. Lavy 1999. "Using Maimonides Rule to estimate the effect of class size on scholastic achievement". *Quarterly Journal of Economics*, 114 (2): 533–75.
- Basta, S.S., D. Soekirman, D. Karyadi and N.S. Scrimshaw. 1979. "Iron deficiency anemia and the productivity of adult males in Indonesia". *American Journal of Clinical Nutrition*, 32 (4): 916–25.
- Behrman, J. and A. Deolalikar. 1988. "Health and nutrition". In H. Chenery and T. Srinivasan, eds., *The Handbook of Development Economics*, Volume I.. Amsterdam: Elsevier Science Publishers.
- Behrman, J., A. Foster and M. Rosenzweig. 1997. "The dynamics of agricultural production and the calorie-income relationship: Evidence from Pakistan". *Journal of Econometrics*, 77: 187–207.
- Ben-Porath, Yoram. 1984. "Fertility response to child mortality – Micro data from Israel". *Journal of Political Economics*, 84 (4): 163–78.
- Bhargava, A. 1997. "Nutritional status and the allocation of time in Rwandese households". *Journal of Econometrics*, 77 (1): 277–95.
- Bhat, P.N. Mari, K. Navaneetham and S. Irudaya Rajan. 1995. "Maternal mortality in India: Estimates from a regression model". *Studies in Family Planning*, 26 (4): 217–32.
- Bhatai, J. and J. Cleland. 1995. "Determinants of maternal care in a region in South India". *Health Transition Review*, 5: 127–42.
- Bliss, C. and N. Stern. 1978. "Productivity, wages and nutrition; Parts I and II: The theory". *Journal of Development Economics*, 5: 331–98.
- Blundell, R. and I. Walker. 1982. "Modelling the joint determination of household labour supplies and commodity demands". *Economic Journal*, 92: 351–64.
- Browning, M. and C. Meghir. 1991. "The effect of male and female commodity demands on labour supply". *Econometrica*, 59: 925–51.

- Carroli, G., C. Rooney and J. Villar. 2001. "How effective is antenatal care in preventing maternal mortality and serious morbidity? An overview of the evidence". *Paediatric and Perinatal Epidemiology*, 15 (suppl. 1): 1–42.
- Chamberlain, G. 1980. "Analysis of covariance with qualitative data". *Review of Economic Studies*, 47: 225–38.
- Chambers, Robert. 2001. "The best of both worlds". Paper prepared for the workshop on Qualitative and Quantitative Poverty Appraisal held at Cornell University, 15–16 March 2001.
- Chiappori, P.-A. 1988. "Rational household supply". *Econometrica*, 54: 63–89.
- Chiappori, P.-A. 1992. "Collective labour supply and welfare". *Journal of Political Economy*, 100: 437–67.
- Cleland, J., J. Phillips, S. Amin and G. Kamal. 1994. *The Determinants of Reproductive Change in Bangladesh: Success in a Challenging Environment*. World Bank Regional and Sectoral Studies. Washington, D.C.: The World Bank.
- Conde-Agudelo, A. and J. Belizan. 2000. "Maternal morbidity and mortality associated with interpregnancy interval: Cross sectional study". *BMJ*, 321: 1255–9.
- Dehn, Jan, Ritva Reinikka and Jakob Svensson. 2003. "Survey tools for assessing performance in service delivery". In Francois Bourguignon and Luiz Pereira da Silva, eds., *The Impact of Economic Policies on Poverty and Income Distribution: Evaluation Techniques and Tools*. New York: Oxford University Press for the World Bank.
- Deininger, K. and P. Mpuga. 2005. "Economic and welfare impacts of the abolition of health user fees: Evidence from Uganda". *Journal of African Economies*, 14: 55–91.
- Deolalikar, A.B. 1988. "Nutrition and labour productivity in agriculture: Estimates for rural South India". *Review of Economics and Statistics*, 70 (3): 406–13.
- Devarajan, Shantanaya and Ritva Reinikka. 2004. "Making services work for the poor people". *Journal of African Economies*, 13: i142–i166.
- Dor, A., P. Gertler and J. Van Der Gaag. 1987. "Non-price rationing and the choice of medical care providers in rural Côte d'Ivoire". *Journal of Health Economics*, 6: 291–304.
- Dow, W., P. Gertly, R.-F. Schoeni, J. Strauss and D. Thomas. 1997. "Health care prices, health and labour outcomes: Experimental evidence". Labour and Population Working Paper Series No. 97-01 (Jan, 1997). RAND, Santa Monica, California.
- Duan, N., W. Manning, C. Morris and J. Newhouse 1984. "Choosing between the sample selection and multi-part model". *Journal of Business & Economic Statistics*, 2 (3): 283–89.
- Dyson, T. and M. Murphy. 1985. "The onset of fertility transition". *Population and Development Review*, 11: 399–440.
- FANTA. 2006. "Maternal anemia: A preventable killer". Food and Nutrition Technical Assistance project. Retrieved on 2 November 2006 at <http://www.fantaproject.org/index.shtml>.

- Fortney, Judith A. 1987. "Importance of family planning in reducing maternal mortality". *Studies in Family Planning*, 18 (2): 109–114.
- Garner, P. and A. Gulmezoglu. 2001. "Prevention versus treatment for malaria in pregnant women – Cochrane review". In *The Cochrane Library*. Oxford: Update Software.
- Gertler, P., L. Locay and W. Sanderson. 1987. "Are user fees regressive? The welfare implications of health care financing proposals in Peru". *Journal of Econometrics*, 36: 67–88.
- Glick, Peter and David E. Sahn. 1998. "Health and productivity in a heterogeneous urban labour market". *Applied Economics*, 30 (2): 203–16.
- Graham, W., A. Fitzmaurice, J. Bell and J. Cairns. 2004. "The familial technique for linking maternal death with poverty". *The Lancet*, 363: 23–7.
- Greene, W. 2003. *Econometric Analysis*. Upper Saddle River, NJ: Prentice Hall.
- Grossman, M. 1972. "On the concept of health capital and the demand for health". *Journal of Political Economy*, 80: 223–55.
- Haddad, Lawrence J. and Howarth E. Bouis. 1991. "The impact of nutritional status on agricultural productivity: Wage evidence from the Philippines". *Oxford Bulletin of Economics and Statistics*, 53 (1): 45–68.
- Hay, J. and R. Olsen. 1984. "Let them eat cake: A note on comparing alternative models of the demand for medical care". *Journal of Business and Economic Statistics*, 2 (3): 279–82.
- Hoddinott, J. and L. Haddad. 1995. "Does female income share influence household expenditures? Evidence from Côte d'Ivoire". *Oxford Bulletin of Economics and Statistics*, 57 (1): 77–96.
- Higgins, P. and H. Alderman. 1992. "Labour and women's nutrition: A study of energy expenditure, fertility, and nutritional status in Ghana". Policy Research Working Paper No. 1009. The World Bank, Washington, D.C.
- Immink, M.D, F.E. Viteri and R.W. Helms. 1981. "Food substitution with worker feeding programs: Energy supplementation in Guatemalan sugarcane workers". *American Journal of Clinical Nutrition*, 34 (10): 2145–50.
- Jakubson, G. 1991. "Estimation and testing of the union wage effect using panel data". *Review of Economic Studies*, 58: 971–91.
- Jones, A. 2000. "Health Econometrics" In A. Culyer and J. Newhouse, eds., *Handbook of Health Economics*, Volume 1A. Amsterdam: Elsevier Science Publishers.
- Kahenya, G. and S. Lake. 1994. *User Fees and Their Impact on Utilisation of Key Health Services*. Lasaka: UNICEF.
- Kaufman, J. 2005. "China: The intersections between poverty, health inequity, reproductive health and HIV/AIDS". *Development*, 48: 113–19.
- Khan, K., D. Wojdyla, L. Say, A. Gulmezoglu and P. Van Look. 2006. "WHO analysis of causes of maternal death: A systematic review". *The Lancet*, 367: 1066–74.
- Kinal, T. 1980. "The existence of moments of k-class estimators". *Econometrica*, 48: 241–9.

- Koblinsky, M., ed. 2003. *Reducing Maternal Mortality: Learning from Bolivia, China, Honduras, Indonesia, Jamaica, and Zimbabwe*. Washington, D.C.: The World Bank.
- Kremer, M. 1993. "Population growth and technological change: One million B.C. to 1990". *Quarterly Journal of Economics*, 113: 681–716.
- Lundberg, S. and R.A. Pollak. 1993. "Separate spheres bargaining and the marriage market". *Journal of Political Economy*, 101 (6): 988–1010.
- Lundberg, S., R.A. Pollak and T.J. Wales. 1997. "Do husbands and wives pool their resources? Evidence from the United Kingdom child benefit". *Journal of Human Resources*, 32 (3): 463–80.
- Magadi, M., N. Madise and R. Rodrigues. 2000. "Frequency and timing of antenatal care in Kenya: Explaining the variations between women of different communities". *Social Science and Medicine*, 51: 551–61.
- Manning, W., N. Duan and W. Rogers. 1987. "Monte Carlo evidence on the choice between sampleselection and two-part models". *Journal of Econometrics*, 35: 59–82.
- Mantel, G., E. Buchmann, H. Rees and R. Pattinson. 1998. "Severe acute maternal morbidity: A pilot study of a definition for a near-miss". *International Journal of Obstetrics & Gynecology*, 105 (9): 985–90.
- McElroy, Marjorie B. 1990. "The empirical content of Nash-bargained household behaviour". *Journal of Human Resources*, 25 (4): 559–83.
- McElroy, M.B. and M.J. Horney. 1990. "Nash bargained household decisions: Reply". *International Economic Review*, 31 (1): 237–42.
- Miaffo, C., F. Some, B. Kouyate, A. Jahn and O. Mueller. 2004. "Malaria and anemia prevention in pregnant women of rural Burkina Faso". *BMC Pregnancy and Childbirth*, 4: 18.
- Merchant, K. 1994. "Maternal nutritional depletion". *United Nations Standing Committee on Nutrition (SCN) News*, 11: 30–2
- Meyerhoefer, C., D. Sahn and S. Younger. 2007. "The joint demand for health care, leisure, and commodities: Implications for health care finance and access in Vietnam". *Journal of Development Studies*, 43 (8): 1475–500.
- Monteith, R., C. Warren, E. Stanziolo, U. Lopez and M. Oberle. 1987. "Use of maternal and child health services and immunisation coverage in Panama and Guatemala". *Bulletin of the Pan American Health Organisation*, 21 (2): 1–15.
- Mroz, T. 1999. "Discrete factor approximations in simultaneous equation models: Estimating the impact of a dummy endogenous variable on a continuous outcome". *Journal of Econometrics*, 92: 233–74.
- Mwabu, G., J. Mwanzia and W. Laimbila. 1995. "User charges in government health facilities in Kenya". *Health Policy and Planning*, 10 (2): 164–70.
- Narayan, D., D. Narayan-Parker and M. Walton, eds. 2000. *Voices of the Poor: Can Anyone Hear Us?* Oxford and New York: Oxford University Press for the World Bank.

- Narayan, D., R. Chambers, M. K. Shaw and P. Petesch. 2000. *Voices of the Poor: Crying Out for Change*. New York and Oxford: Oxford University Press for the World Bank.
- Nour, N. 2006. "Health consequences of child marriage in Africa". *Emerging Infectious Diseases*, 12: 1644–9.
- Obermeyer, C. and J. Potter. 1991. "Maternal health care utilisation in Jordan: A study of patterns and determinants". *Studies in Family Planning*, 22: 177–87.
- Olsen, Randall J. 1980. "Estimating the effect of child mortality on the number of births". *Demography*, 17 (4): 429–43.
- Overbosch, G., N. Nsawah-Nuamah, G. Van Den Boom and L. Damnyag. 2004. "Determinants of antenatal care use in Ghana". *Journal of African Economies*, 13: 277–301.
- Pebley, A, R. Goldman and N. Rodriguez. 1996. "Prenatal and delivery care and childhood immunisation in Guatemala: Do family and community matter?" *Demography*, 33: 231–47.
- Pitt, M., M.R. Rosenzweig and M.N. Hassan. 1990. "Productivity, health and inequality in the intrahousehold distribution of food in low-income countries". *American Economic Review*, 80 (5): 1139–56.
- Pojda, J. and L. Kelly. 2000. *Low Birthweight*. Nutrition Policy Paper No. 18. Geneva: United Nations Committee on Coordination, Sub-Committee on Nutrition.
- Poskitt, E. 1995. "Nutrition in the rural African woman: Studies from Keneba, The Gambia". Paper presented at the 25th IFUW Triennial Conference, Yokohama, Japan, 18–25 August.
- Potter, J., O. Mojarro and L. Nunez. 1987. "The influence of health care on contraception acceptance in rural Mexico". *Studies in Family Planning*, 18 (3): 144–56.
- Raghupathy, S. 1996. "Education and the use of maternal health care in Thailand". *Social Science and Medicine*, 43: 459–71.
- Ravallion, Martin. 2001. "Growth, inequality and poverty: Looking beyond averages". *World Development*, 29 (11): 1803–15.
- Reinikka, Ritva. 2001. "Recovery in service delivery: Evidence from schools and health centres". In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. World Bank Regional and Sectoral Studies. Washington, D.C.: The World Bank.
- Reinikka, Ritva and Jakob Svensson. 2002a. "Assessing frontline service delivery". Processed. Development Research Group, The World Bank, Washington, D.C.
- Reinikka, Ritva and Jakob Svensson. 2002b. *Explaining Leakage of Public Funds*. CEPR Discussion Paper No. 3227. Centre for Economic Policy Research, London, UK.
- Reinikka, Ritva and Jakob Svensson. 2003. "The power of information: Evidence from an information campaign to reduce capture". Processed. Development Research Group, the World Bank, Washington, D.C.

- Ross, J. and J. Habicht. 1995. *Patterns and Determinants of Maternal Nutritional Status During Lactation in Malawi*. Research Monograph. Washington, D.C.: Wellstart International.
- Sahn, David and Ari Gerstle. 2004. "Child allowances and allocative decisions in Romania households." *Applied Economics*, 36 (14): 1513–21.
- Sahn, David E. and David C. Stifel. 2000. "Poverty comparisons over time and across countries in Africa". *World Development*, 28 (12): 2123–55.
- Sahn, David E. and David C. Stifel. 2002. "Parental preferences for nutrition of boys and girls: Evidence from Africa". *Journal of Development Studies*, 39 (1): 21–45.
- Sahn, David and Stephen Younger. 2000. "Expenditure incidence in Africa: Microeconomic evidence". *Fiscal Studies*, 21 (3): 329–48.
- Sahn, D.E., S.D. Younger and G. Genicot. 2003. "The demand for health care services in rural Tanzania". *Oxford Bulletin of Economics and Statistics*, 65: 241–60.
- Sahn, David E., Paul Dorosh and Stephen D. Younger. 1997. *Structural Adjustment Reconsidered: Economic Policy and Poverty in Africa*. Cambridge: Cambridge University Press.
- Schoumaker, B. 2004. "Poverty and fertility in Sub-Saharan Africa: Evidence from 25 countries". Paper presented at the Population Association of America Meeting, Boston. <http://paa2004.princeton.edu/download.asp?submissionId=40032>.
- Selden, Thomas M. and Michael J. Wasylenko. 1992. "Benefit incidence analysis in developing countries". Policy Research Working Papers WPS 1015. Public Economics Department, the World Bank, Washington, D.C.
- Short, S. and F. Zhang. 2004. "Use of maternal health services in rural China". *Population Studies*, 58: 3–19.
- Singh, I., L. Squire and J. Strauss, eds. 1986. *Agricultural Household Models: Extensions, Applications and Policy*. Washington, D.C.: The World Bank.
- Smith, Kevin, Christopher B. Barrett and Paul W. Box. 2001. "Not necessarily in the same boat: Heterogeneous risk assessment among East African pastoralists". *Journal of Development Studies*, 37 (5): 1–30.
- Stiglitz, J. 1976. "The efficiency wage hypothesis, surplus labour, and the distribution of income in LDCs". *Oxford Economic Papers*, 28: 185–207.
- Steketee, R., B. Nahlen, M. Parise and C. Menendez. 2001. "The burden of malaria in pregnancy in malaria-endemic areas". *American Journal of Tropical Medicine and Hygiene*, 64: 28–35.
- Strauss, J. 1986. "Does better nutrition raise farm productivity?" *Journal of Political Economy*, 94 (2): 297–320.
- Strauss, J. and D. Thomas. 1997. "Health and wages: Evidence on men and women in urban Brazil". *Journal of Econometrics*, 77 (1): 159–85.

- Strauss, J. and D. Thomas. 1995. "Human resources: Empirical modelling of household and family decisions". In J. Behrman and T. Srinivasan, eds., *The Handbook of Development Economics*, Volume III. Amsterdam: Elsevier Science Publishers.
- Strauss, J. and D. Thomas. 1998. "Health, nutrition and economic development". *Journal of Economic Literature*, 36 (2): 766–817.
- Strong, M. 1998. "The effect of adult mortality on infant and child mortality". Unpublished paper presented at the Workshop on the Consequences of Pregnancy, Maternal Morbidity and Mortality for Women, Their Families and Society, Nairobi, 19–20 October. Available from USAID, Nairobi, Kenya.
- Swafford, J. and G. Whitney. 1987. "Nonparametric tests of utility maximisation and weak separability for consumption, leisure, and money". *Review of Economics and Statistics*, 69: 458–64.
- Tabata, K. 2003. "Inverted U-shaped fertility dynamics, the poverty trap and growth". *Economics Letters*, 81: 241–8.
- Thomas, D. 1990. "Intra-household resource allocation: An inferential approach". *Journal of Human Resources*, 25 (4): 635–64.
- Thomas, D. 1993. "The distribution of income and expenditure within the household". *Annales de Economie et de Statistiques*, 29: 109–36.
- Trussel, James and Anne R. Pebley. 1984. "The potential impact of changes in fertility on infant, child and maternal mortality". *Studies in Family Planning*, 15 (6): 267–80.
- Tsu, V.D. 1994. "Antenatal screening: Its use in assessing obstetric risk factors in Zimbabwe". *Journal of Epidemiology and Community Health*, 48 (3): 297–305.
- Ulph, D. 1988. "A general non-cooperative Nash model of household consumption behaviour". Mimeo. Bristol University.
- UNSCN. 2004. *The Fifth Report on the World Nutrition Situation: Nutrition for Improved Development Outcomes*. New York: United Nations Standing Committee on Nutrition.
- Van de Walle, Dominique. 2003. "Are returns to investment lower for the poor? Human and physical capital interactions in rural Viet Nam". *Review of Development Economics*, 7 (4): 636–53.
- Viteri, F.E., B. Torún, M.D. Immink and R. Flores. 1981. "Marginal malnutrition and working capacity". *Progress in Clinical and Biological Research*, 77: 277–83.
- Waddington, C.J. and K.A. Enyimayew. 1990. "A price to pay: The impact of user charges in the Volta Region of Ghana". *International Journal of Health Planning and Management*, 5 (4): 287–312.
- Warren, C., R. Monteith, J. Johnson, R. Santiso, F. Guerra and M. Oberle. 1987. "Use of maternal-child health services and contraception in Guatemala and Panama". *Journal of Biosocial Science*, 19: 229–43.
- Winikoff, B. and M. Sullivan. 1987. "Assessing the role of family planning in reducing maternal mortality". *Studies in Family Planning*, 18 (3): 128–43.

- Wooldridge, J. 2002. *Econometric Analysis of Cross Sectional and Panel Data*. Cambridge, Massachusetts: The MIT Press.
- Wolfe, B. and J. Behrman. 1987. "Women's schooling and children's health: Are the effects robust with adult sibling control for the woman's childhood background". *Journal of Health Economics*, 6 (3): 239–54.
- Wolgemuth, J.C., M.C. Latham, A. Hall, A. Chesher and D.W. Crompton. 1982. "Worker productivity and the nutritional status of Kenyan road construction labourers". *American Journal of Clinical Nutrition*, 36 (1): 68–78.
- WHO. 1992. *International Statistical Classification of Diseases and Related Health Problems. Tenth Revision*. Geneva: World Health Organisation.
- WHO. 1997. *Maternal Health around the World*. Wall chart available from Department of Reproductive Health and Research, World Health Organisation, Geneva.
- WHO/UNICEF/UNFPA. 2004. *Maternal Mortality in 2000: Estimates Developed by WHO, UNICEF, UNFPA*. Geneva: World Health Organisation.
- Yitzhaki, S. and J. Slemrod. 1991. "Welfare dominance: An application to commodity taxation". *American Economic Review*, 81 (3): 480–96.
- Yoder, R. 1989. "Are people willing and able to pay for health services?" *Social Science and Medicine*, 29 (1): 35–42.

Women's Labour Market Choices: Fertility, Poverty and Demographic Linkages

Stephen D. Younger

Women in poor countries tend to have high fertility and their children have high infant and child mortality rates. In rich countries, women tend to have low fertility and their children have low infant and child mortality rates. Thompson (1929) and Notestein (1945) described the change from the first state to the second as the demographic transition, one of the most studied ideas in the social sciences. Thompson's basic description is compelling: Countries begin with high birth and death rates (Stage 1). At some point, death rates decline substantially, but birth rates do not (Stage 2). This stage involves substantial population growth. Then, birth rates also fall, and population growth begins to moderate (Stage 3). Stage 4 has both low birth and death rates.

What is more controversial is *why* this transition occurs; that is, what causes each of the changes that Thompson described. Initial declines in mortality have been attributed to better health care; better sanitation; better, variable food supplies; and better education and understanding of the causes of disease (especially among mothers). The ensuing decline in births has been attributed to a wide range of factors, from the prior decline in mortality (if infant and child deaths are less likely, mothers do not need as many births to achieve a "target" number of children) to access to modern contraception and increased education (especially of women). Other contributors are urbanisation, reduced reliance on subsistence agriculture (where children are productive hands) and improved social insurance for retirees. Changing norms about what constitutes a fulfilling life for women are also important, as are the improved status of women, increased power of women within families and increased labour market opportunities for women. While each of these explanations has *prima facie* plausibility, their relevance to the demographic transition in any particular country is often hotly debated. In Western Europe, for example, the demographic transition took place before the advent of either modern medicine or modern contraception. Yet both are surely important features of the transitions in today's developing countries.

Further complicating an interpretation of the demographic transition is that many of the factors cited are clearly inter-related, with plausible interpretations about causality running in both directions. Increased education for girls may help to

reduce fertility for a variety of reasons: delayed onset of marriage and the first birth (in order to finish school), changed attitudes about what women should do (study and work rather than have many children), improved knowledge of health and birth control, and so on. But it is also reasonable to suppose that reduced fertility, especially reduced teen pregnancies, increases girls' education by allowing them to stay in school. Untangling the many structural links among fertility, mortality, and poverty is complex both conceptually and empirically.

This chapter focuses on one aspect of the demographic transition, women's labour market activity, and how it relates to the basic variables of fertility and poverty. Just as there are differences in fertility and mortality in rich and poor countries, there are differences in women's time use. In rich countries, women tend to work outside the home, usually in wage employment on a fixed hourly schedule. In poor countries, women tend to work at home or, especially in Africa, on their family's farm or at own-account activities where time use is more flexible. Understanding the relationship between the demographic transition and these differences in time use is our main theme.

This topic is important for African policy makers interested in poverty reduction. Increasing employment opportunities for women, or increasing wages in existing employment opportunities, can lead to significant reductions in fertility as women choose to spend less time bearing and raising children and more time at work. Both of these effects lead to reduced poverty: the decline in fertility leads to "fewer mouths to feed," and the increase in labour market activity increases household incomes. It is important to note that this effect is probably stronger for improvements in *women's* employment and wages than it is for men's, for reasons that we discuss below. In a similar vein, induced reductions in fertility through, say, improved access to reproductive health services, can lead to the same reallocation of time use for women, with similar results for poverty reduction.

Theory

The theory of women's labor market and fertility behavior addresses how women allocate their scarce resources to achieve their goals. This includes decisions about time allocation between work and child rearing, about fertility, and about the investments a woman makes in her children.

The Work/Fertility Trade-Off

In general, women (and their families) choose both their fertility and their labour market activities. As such, both are endogenous variables, so it does not make sense to think of one causing the other in a reduced form sense – both are determined by a larger set of constraints and circumstances. A simple model of a mother's choices¹ might have the form:

$$\max U(N, C) \text{ subject to} \quad (1)$$

$$N = f(T_H, Z), \quad (2)$$

$$P_c \cdot C + p_z \cdot Z = w \cdot T_W + Y, \quad (3)$$

$$T_W + T_H = T. \quad (4)$$

Utility is a function of the number of children, N , and consumption, C , while $f(T_H, Z)$ is a child production function with inputs T_H , the time spent raising children, and other purchased inputs Z . Total income is the sum of earned income – the wage rate, w , times time worked (T_W) – plus unearned income, Y . Income is spent on consumption and on inputs to the production of children. Finally, each mother faces a time constraint such that time spent raising children and working are mutually exclusive. For simplicity, we ignore leisure, both here and in the utility function.

How do women's labour market opportunities affect time allocations, fertility and poverty? In this simple model, the wage rate, w , offered to women captures "labour market opportunities", and we take it as exogenous.² If the wage rate on offer increases, there are three effects. First, there is the substitution effect, which entails spending more time working for wages and less time producing children. Holding all else constant, this would lead to less fertility, greater income and less poverty (as measured by income per capita). But there is also an income effect: as long as $T_W > 0$, the wage increase makes women richer, which leads to greater demand for both consumption *and* children, assuming that both are normal goods. Thus, it seems that the effect on poverty is clear, but the effect on fertility and time allocation is less so. The ambiguity comes from the well-known backward bending labour supply curve in which, at sufficiently high wages, the income effect almost surely overcomes the substitution effect to produce less labour supply, T_W , as the wage rises. The corresponding increase in time spent producing children, T_H , would increase fertility, all else constant.

Empirically, we have long observed that an increase in women's wages is accompanied by lower fertility (De Tray, 1973), which suggests that the substitution effect dominates the income effect in this case. One reason for this may be that time spent working at wage labour cannot be chosen continuously, but is either zero or some fixed amount, like 40 hours per week. In that case, any reduction in hours has to be to zero, and so eliminates the income effect, since at zero hours, labour income is zero regardless of how high the wage rate is.

There is a third effect in this model that might allow increased wages to lead to increased fertility. As wages increase, even if time spent working increases and time spent producing children declines, that decline may be offset by greater purchases of the inputs Z , which are made possible by the increased income from a wage increase. This, too, runs counter to what we observe empirically, so we must ask why this effect does not seem to be too important. The technical reason is that T_H and Z must not be easily substituted for one another. To some extent, this is a biological imperative: to have children, mothers must spend an unavoidable

minimum amount of time not working at wage labour. But that amount of time is relatively brief, and some (though certainly not all) countries enforce labour legislation that requires firms to provide maternity leave of a few weeks to a few months. In many cultures, however, there is a social expectation that mothers will spend considerably more than the biological minimum time raising their children. Such norms will make the work/fertility trade-off more severe, and increase the impact of wage changes, or labour market opportunities more generally, on fertility.

To be precise, we should say “certain types of work.” As we have noted, in developed countries where much of this literature comes from, work for women means formal sector wage employment with fixed time schedules. Such jobs are incompatible with spending time raising children. In Africa, however, women do many types of work that are at least somewhat compatible with child care. For example, African women often do agricultural work accompanied by their children, with infants strapped to their back. It is also possible to undertake some kinds of informal self-employment like trading while simultaneously caring for children. This joint production clearly eases the time constraint and thus the trade-off between women’s work and child care.³

Nevertheless, there are some types of work, particularly regular wage labour, for which joint production is difficult or impossible. Women cannot usually take their children with them to factories, offices, plantations, or call centres. For these jobs, the trade-off between employment and fertility is real. And as it happens, these are the jobs most likely to be associated with economic development and poverty reduction. This helps to explain why it is that we tend to observe high fertility with poverty and vice-versa. Again, we are not attributing causation to either factor. We simply note that the time constraint will force this correlation.

Another feature of African labour markets that sharpens the work/fertility trade-off is migration. Many types of employment, whether formal or informal, will require a change in location, usually rural-to-urban migration. In Africa, such migration sometimes separates spouses as the employed family member moves, but the family remains behind. This has an obvious direct impact on fertility, and it may also reduce the incentives to higher fertility by raising the cost of child rearing. Thus, employment opportunities and migration are closely related in many African economies.

In the model above, women choose an optimal number of hours to work outside the home, T_w . But most wage labour jobs have inflexible working hours, which may exacerbate the work/fertility trade-off. First, the time demands of child care are variable. During most days, it may be possible to work nine-to-five each day and still tend to one’s children, but not when a child is sick, for example. But many wage jobs do not allow employees the flexibility to respond to these variable demands for child care by missing work. That, too, sharpens the wage work/fertility trade-off.

On the other hand, there are circumstances that can ease the trade-off. We have already mentioned joint production. For mothers employed in the formal sector, child care services provided either by the employer or the public sector are sometimes available (though rarely in Africa). It may also be possible to purchase child care services by hiring a nanny. More likely, family members may substitute for the mother's time at child care. So we might want to rewrite the child production function as

$$N = f(T_H, T_O, Z)$$

where T_H is mother's time spent with children, and T_O is the time of other family members spent at child care. This function may still have little or no substitution between time (the T_i 's) and other inputs (Z), but substitution of different family members' time may be sufficient to allow women to pursue work outside the home while still having children.

At first glance, this possibility would seem to ease the work/fertility trade-off for women, and perhaps allow both increased incomes and fertility. However, other household members' time is not without its own opportunity costs. In particular, it is not unusual for older siblings, usually girls, to be charged with child care in families where mothers are unable to allocate sufficient time to that activity. If this means that they cannot attend school, it sets up a dynamic relationship between poverty and high fertility today and in the future. Girls from poor families with high fertility who do not finish school will have poor labour market opportunities (lower w in this model) and so be more likely to not participate in wage labour and to have high fertility themselves.

The Child "Quantity/Quality" Trade-Off

We have seen that it is possible to develop a model of the fertility/work trade-off in which an increase in women's wages or wage employment opportunities yields reduced fertility, higher money incomes and lower poverty. But that result is far from certain, requiring limited substitutability for a woman's time in the raising of her children and income effects that are not too strong. In a seminal paper, Becker and Lewis (1973) strengthen the argument that increases in women's wages or wage employment opportunities will lead to lower fertility and higher incomes. They noted that parents care not only about the quantity of children that they have, but also each child's quality, which we can interpret roughly as the child's human capital. Surprisingly, the Becker-Lewis model indicates that the observed income effect for fertility may be negative even when children are a normal good. That is, when money income increases, even if it is not from increased wages, it may cause a reduction in the number of children demanded.

To see why, add child quality, Q , to the utility function above:

$$U = U(N, Q, C)$$

and ignore for the moment the labour supply decision.⁴ Families maximise this utility subject to an income constraint:

$$I = N \cdot Q \cdot p + C \cdot p_C$$

where p is the price of $N \cdot Q$ (number of children times their quality) and p_C is the price of consumption goods. Note that this income constraint assumes that each child will be of the same quality Q , which is optimal if the quality production function has diminishing returns. The first order conditions for this problem are:

$$dU/dC = l \cdot p_c$$

$$dU/dN = l \cdot (Q \cdot p) = l \cdot p_N$$

$$dU/dQ = l \cdot (N \cdot p) = l \cdot p_Q$$

where l is the marginal utility of income. The unusual thing about these results is that the marginal cost of N , or its shadow price, $p_{H=N}$, depends on Q , and vice-versa. In most cases, this marginal cost is the market price of a good, as it is for the consumption good C here. But for the quantity and quality of children, the marginal cost actually depends on the endogenous value of another choice variable because of their interaction in the budget constraint. This gives rise to two unusual results.

First, consider the effect of income on the number of children demanded (fertility). If we assume that children are normal goods, then the true income effect will be positive. However, the observed income effect can actually be negative. When income rises, it increases the demand for child quality, Q .⁵ This increase in Q , in turn, increases the shadow price of child quantity, $Q \cdot p$, which will decrease the demand for N . The overall observed effect of income on the demand for child quantity has two components: the usual income effect, assumed to be positive, and the induced effect that comes from greater demand for child quality, which is negative. There is no reason to believe that either one of these effects dominates, although Becker and Lewis argue that the true income elasticity of demand for child quantity may be small. For our purposes, however, the key point is that the observed income elasticity of demand for child quantity could be negative. That would produce the often-observed correlation of higher incomes and lower fertility even if the increased income is not coming from (women's) wages and thus does not involve the substitution effect for time allocations discussed in the previous section. Note that if we combine this model with the work/fertility model of the previous section, then an increase in women's wages (or labour market opportunities more generally) may cause reductions in fertility for two reasons: the standard substitution effect towards greater work, and this potentially negative income effect.

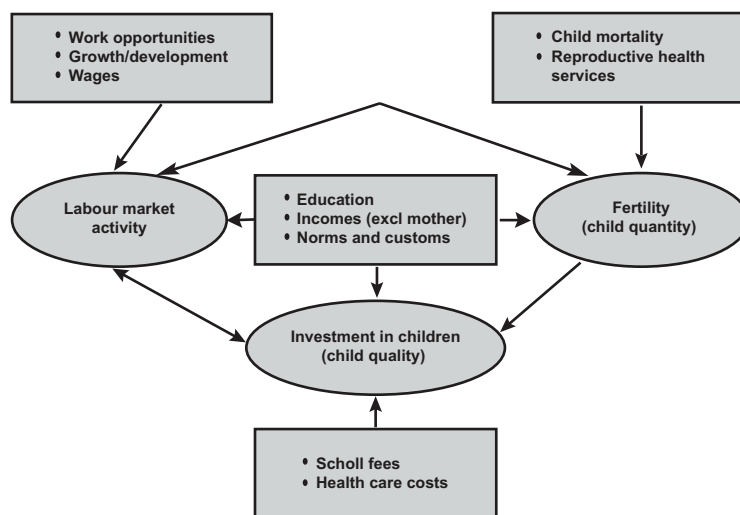
The second notable result of the Becker–Lewis model has to do with price effects. Suppose that family planning services become more affordable. We can interpret this as a rise in the price of child quantity (because it is a reduction in the cost of limiting that quantity). This has a pure substitution effect of reducing the demand for the number of children. But that demand will shift towards greater child quality

unless quantity and quality are strongly complementary. The increased quality, in turn, increases the shadow price of child quantity, further reducing the demand for the number of children. At the same time, the reduced demand for the number of children reduces the shadow cost of child quality, inducing a further substitution toward greater quality. Thus, even though child quantity and quality may not be closer substitutes than either is for other goods, C , the observed cross-price elasticities between these two goods will be stronger than their cross-price elasticities to consumption. This presents the possibility that relatively small changes in the prices of child quantity or quality will induce large changes in fertility.

Summary

If we combine the arguments in the previous two sections, we have a model with three endogenous variables: women's labour supply, fertility (child quantity) and investments in children's human capital (child quality). Willis (1973) analyses this model in detail. While these variables are jointly determined, and thus it does not make sense to think about causation among them, there are important feedback loops among them, and exogenous variables like the availability of family planning services will affect each of the three variables as women adjust their time use, fertility and investments in their children to changing circumstances.

Figure 12.1: Modelling labour market, fertility and child investment choices



To fix ideas, consider Figure 12.1. The ovals are the three endogenous variables that we have been discussing and the boxes are exogenous variables, including public policies that may affect them. The exogenous variables are divided into four somewhat artificial groups. There are factors that seem most obviously associated

with the labour market, like wages and employment opportunities. There are those mostly associated with fertility, like access to reproductive health care or child mortality probabilities. There are those most associated with investments in children, like school fees. And there are some factors that condition all of these effects, most notably education, income from sources other than the mother, and attitudes or norms.

Labour market opportunities

For a variety of reasons – discontinuities in hours worked, child rearing being considered women's work, and the unusual interaction of child quantity and quality in the opportunity cost of the other – increased wages for women are likely to generate greater labour supply, lower fertility, greater demand for child quality and greater money incomes for women. Further, the last two effects will yield lower poverty.

It is worth noting here that education levels (in the centre box) will interact with the general structure of wage rates in determining labour supply, fertility and investments in children. Better educated women will earn higher wages and so have a greater incentive to work, reduce fertility and increase investments in their children. This helps to explain why education is consistently correlated with lower fertility.

While economists love to analyse prices, in this particular case, job opportunities, especially opportunities for the kind of formal sector wage employment that is least compatible with fertility, are probably more important. Here, the prognosis for Africa is discouraging. Very few people have formal sector employment in Africa, and such employment is more common for men than women. Especially in rural areas, women's opportunities for formal wage work are almost nonexistent, making wage rates irrelevant. There are simply no jobs of this type available. Nevertheless, there are examples of economic development that requires wage employment and at least one of the most common industries, textiles and garments, appears to have a preference for female employees. The same is true of the emerging cut flower industry and (perhaps) call centres. Introduction of these industries would produce the same sort of effects that we have seen for wage increases. By increasing the demand for (women's) labour, we can reasonably expect that this type of labour-intensive economic development will lead to lower fertility, greater investments in children, and less poverty.

Direct influences on fertility

Turning now to the factors that are directly linked with fertility decisions, we can discern that children's mortality probabilities played a central role in the original ideas about the demographic transition. The basic idea is that parents have a desired number of children that they would like to see grow to adulthood. If they know that the probability of infant and child deaths is high, then they will have more children to account for that possibility. But once they are convinced that the mortality

probabilities are low, they will also reduce fertility. On this view, the interpretation of the demographic transition is one in which infant and child mortality first fall, but it takes time for parents to recognise this and take it into account in their fertility decisions. Once they do, fertility also declines, and the transition is complete.

One problem with this interpretation is that people in poor countries seem to want far more children than are necessary to compensate for high child mortality levels. Even in very poor countries, child mortality is rarely higher than 20 per cent, so parents wanting only two children to survive to adulthood – the number necessary for long-run population stability – would only need to have 2.4 births on average. Yet survey respondents usually report much higher desired fertility levels in Africa. Of course, not every parent's children suffer the average rate of mortality. If the risks of having few or no children survive are high, then parents might have very high desired fertility to offset those risks. Even so, they would need to be extremely risk averse to justify the desired fertility rates observed in Africa. Other factors, such as a desire to have additional farm laborers or to have greater support in old age, must also influence these demands for high fertility. Nevertheless, reductions in child mortality should be expected to have some impact on fertility. Thus, improvements in health care services and public health more generally, including clean water and sanitation, are important variables.

Access to and cost of reproductive health services are also obvious determinants of fertility, women's employment decisions, and investments in children. It should be noted, however, that reproductive health services can lower fertility only if families actually *want* fewer children, which is not always the case, as we have noted. Reduced costs of reproductive health services may have an effect, however, especially for the poor, for whom the typical costs of birth control are a significant share of disposable income.

Finally, possibilities for provision of child care by someone besides the (possibly working) mother is an important consideration. As we have noted, in some instances, the extended family may help to ease the work/fertility trade-off by substituting for the mother in child care. More important for policy makers is the issue of public provision of child care. This remains rare in Africa, but is increasingly the norm in other parts of the world, including many developing countries.

Costs of child quality

The most obvious exogenous influences on child quality are the costs of education and child health services. In this regard, an interesting possibility for research is the experience of many African countries that have recently eliminated school fees. Several studies document the impact of this policy change on school enrolments in Africa, but none that we know of look beyond this impact to examine the effects on fertility or women's labour force choices, both important questions for policy makers.

Other conditioning factors

Women's educational attainment is almost always highly correlated with lower fertility, greater labour force participation and increased investments in their children. Economists usually interpret this effect as operating through wages: Greater education means that women can earn higher wages, increasing the incentives for greater labour force participation and lower fertility along the lines described above. But there is also a sociological argument that education affects girls' attitudes and preferences in ways that encourage lower fertility.

It is tempting to take these correlations as causal, and many empirical studies do so. However, there are two reasons to be cautious on this count. First, if girls and their parents are forward-looking, then they will make decisions about education that take into account the implications for future employment, fertility and child quality of pursuing more education. If this is the case, then we would have to view education as jointly determined with the other three variables, rather than as an exogenous determinant of them. A second reservation comes from the observation that in many cultures, a girl who becomes pregnant cannot continue to study. If that is the case, then fertility (perhaps unplanned) would be causing educational attainment, rather than the other way around.

We have discussed the income and substitution effects of changes in *women's* wages and labour market opportunities, but not other household members' incomes, including unearned income and wealth. Here, there is only an income effect, so we might expect economic development and poverty reduction along these lines to have a positive effect on fertility. Becker and Lewis (1973) reveal why this is probably not the case, again noting that the interaction of child quantity and quality implies that even a pure increase in income will induce a (negative) substitution effect in this case. Butz and Ward (1979) present an early empirical test that supports this argument, albeit for US data.

Economists tend not to pay much attention to attitudes, norms and customs – what we would call preferences – but they are an important area of interest for other social scientists. If women's view of what they should be and do changes in the course of modernisation, then that is consistent with changing demands for children and changing labour supply. Such attitudes may have important interaction effects with the other causal forces that we have considered here. For example, if custom dictates that women are not supposed to work outside the home, then increased employment opportunities or wages may not induce any change in labour supply or fertility.

The link to poverty

Increased employment opportunities for women and lower fertility both influence current poverty directly. Improved education and health status for children are likely to reduce future poverty, as those children will have greater human capital when they are grown.

Empirical Work

Most empirical work on labour supply, fertility, and poverty done by economists and economic demographers falls into three broad types of study. The first and most common in the recent literature uses household survey data to study some subset of the relations laid out in Figure 12.1 at the individual or household level. We will call these micro-level studies. A second type of study, more common in the earlier literature, uses cross-country (or cross-region) data to test relationships between national averages of the variables found in Figure 12.1. And finally, a recent strand of literature uses modern time series methods to estimate structural relations using national averages over time for one country. In this section, we look at the methods used and some key results for Africa in each type of study.

Micro-Level Studies

Among these are studies using structural models, single equation reduced form models and panel data studies. Each methodology has its own advantages and drawbacks. We look at each in turn and consider their applications to a range of related issues.

Structural models

Figure 12.1 naturally suggests estimating a structural model with equations for fertility, investments in children, and labour force participation. Fleisher and Rhodes (1979) is an early example, using data from the National Longitudinal Surveys in the United States.⁶ They do not use system methods like three-stage least squares because the samples for each estimating equation differ. In part, this is simply a matter of data availability, but because the behavioural outcomes from a given decision manifest themselves at different points in time for a given woman, it is often necessary in a cross-section to use one sample to estimate fertility relations, another to estimate the determinants of children's schooling and yet another to estimate labour force participation. These authors do, however, use instrumental variables to handle the endogeneity of our key dependent variables in each equation.

Identifying and interpreting such systems estimates is challenging, and therefore uncommon in the literature. To our knowledge, no such estimation exists for Africa. A more straightforward approach is to estimate the reduced form for each equation – fertility, investments in children and labour force participation. Lam and Anderson's 2002 study is a good example of this approach for Africa. Using data from three rounds of the October Household Survey (OHS) in South Africa, they estimate three separate equations to examine the impact of education on fertility, investments in children (as measured by the level of schooling a child has completed divided by the child's age minus six) and labour force participation. As in any reduced form, each dependent variable is regressed only on a uniform set of variables claimed to be exogenous. In this paper, these were the woman/mother's

education level achieved, the spouse/father's education level, the woman/mother's age, a rural/urban dummy, province dummies, and dummies for the survey year.⁷ Of these, the one policy variable of interest is education, and that is the focus of this chapter: How does women's (and men's) education affect fertility, child schooling and labour force participation.

In theory, there are efficiency gains to estimating the three equations jointly with seemingly unrelated regression, though Lam and Anderson do not do this. The fertility and years of schooling equations are estimated with ordinary least squares (OLS) and the employment equation is a probit. While their sample is unusually large (because the OHS is an unusually large survey), their methods should be applicable in other African countries with simple cross-sectional data sets.

Lam and Anderson discuss key results equation-by-equation, but then interpret their conclusions in the context of the structure of the model in Figure 12.1. The first key result of the paper is that better educated women have lower fertility, but only at relatively high levels of education. Up to at least six years, and perhaps ten years of schooling (depending on the sample), schooling has no significant impact on fertility. This is a common result in Africa, but not Asia or Latin America, where lower levels of schooling do seem to lower fertility. (See Schultz, 1993; Appleton, 1996; and Ainsworth *et al.*, 1996.)

More importantly, Lam and Anderson claim that women's education has even less impact on their probability of employment.⁸ Thus, the participation/fertility trade-off does not seem to be important in South Africa. The authors offer the following interpretation: Education increases productivity in the labour market, but it also increases productivity in child rearing activities. If the effects are roughly proportional, then it is possible to see better educated women having fewer children but not changing their labour force participation. Instead of the work/fertility trade-off, the key is a Becker–Lewis-type argument that the price of child quality falls with greater female education, and that decline encourages a substitution from child quantity to quality.

The third estimated equation backs up this argument by showing a large and significant effect of mother's education on their children's advancement through school. In sum, Lam and Anderson argue that the quantity/quality trade-off is more important than the work/fertility trade-off. We do not necessarily concur with this conclusion, for two reasons. First, as indicated in note 8, the employment data *do* show increased employment probabilities with more education, and at very similar years of education (about ten years for the 35–44-year-old sample and six to eight years for the 45–54-year-old sample). We take this as evidence that the work/fertility trade-off does matter (as does the quality/quantity trade-off). In addition, the peculiarities of the South African labour market, with extremely high unemployment, may cause *employment* probabilities to be quite unresponsive to education, though perhaps not labour force participation probabilities.

Single equation (semi-)reduced form models

We highlight the Lam and Anderson paper because it uses African data, but mostly because it treats our three key endogenous variables jointly, consistent with the theory discussion. But such papers are quite rare, for Africa and elsewhere. Even the Lam and Anderson paper addresses the impact of only two of many possible exogenous variables of interest, women's and men's schooling. It is much more common to find papers that estimate reduced forms or semi-reduced forms for only one of the three endogenous variables. Each of these sets of literature – the determinants of fertility, of labour supply, and of child education and health outcomes – is huge in its own right. We cannot possibly review them here. But we do give reference to a few examples, focusing on specification issues and models using data that are readily available in Africa.

Determinants of women's labour supply. There are many papers on women's labour supply, most of which focus on two key issues: the elasticity with respect to wages, and the relationship between fertility and labour supply. The latter is quite obviously related to the theme of this chapter, but, as our theoretical model indicates, simply including some measure of fertility – e.g., number of young children that a woman has, or her household's size or composition – as an explanatory variable for a labour supply model is mis-specified, since these variables are jointly determined. In particular, it is likely that the bias on such fertility variables is negative, i.e., it will exaggerate the impact of fertility on labour supply. Browning (1992) is particularly critical of these sorts of estimates.

Even though our model suggests that fertility is jointly determined with labour supply, there is a way to estimate the effect of fertility. This relies on the fact that fertility is not entirely deterministic. The birth of some children is a shock – it is not planned or anticipated by the parents. If this shock is unrelated to labour supply decisions, then it is possible to estimate consistently the impact of such fertility shocks on labour supply decisions. The literature contains three approaches to such fertility shocks, each providing a different means of identification.⁹

The first and best-known is due to Rosenzweig and Wolpin (1980). They argue that having twins at the first birth is an unanticipated fertility shock equal to the impact of having a second child.¹⁰ Using data from rural India, they found that women between the ages of 15 and 24 whose first birth was twins had 0.65 more children than women whose first birth was single, but this difference declines to 0.15 more children 20 years later. In either case, firstborn twins do have an impact on fertility, i.e., they are a useful instrumental variable. These women had a 37 per cent lower probability of labour force participation than comparable women whose first birth was single when they were 15–24 years old. By the time they were 35–44 years old, however, they had a 14 per cent *higher* probability of working. In sum, the fertility shock certainly affects labour supply, but an important part of the effect is to alter the timing of labour supply rather than the lifetime supply.

A second approach to fertility shocks is found in Angrist and Evans (1998). Using data from the United States, they indicate that parents whose first two children are of the same sex have higher fertility than those that have a boy and a girl. They argue that this reflects preferences for having children of both genders. As a result, a same-sex indicator is a useful instrument for fertility. They go on to reveal that women whose first two children are of the same gender are about 12 per cent less likely to participate in the labour force.

Finally, Demographic and Health Surveys (DHSs) routinely ask women about whether births were desired or not, and whether they intend to have more children. While one can easily perceive that the first answer might be endogenous because women are reluctant to say that they do not want their children, the second question seems likely to elicit more genuine responses. If so, then a follow-up survey of the same women allows the possibility of identifying unwanted births in the interval between the first and second surveys. While they do not analyse the effect of these unwanted births on mother's labour supply, such an analysis would be possible.¹¹

None of these approaches is a reduced form per se; that is, none studies the impact of an exogenous variable on one or more endogenous ones. Rather, they attempt to understand the structural relationship between two of the endogenous variables in our model. While there is obviously great interest in this relationship, the difficulties of estimating it well are significant.¹²

Simpler reduced form estimates of female labour supply decisions in Africa are rare. The particular decision that interests us – whether or not to work in a formal sector wage job that is incompatible with time spent raising children – is considered even less. One particularly useful paper from this vantage point is Lanot and Muller (1997). These authors estimate women's labour supply with respect to wages taking into account two key features of the African labour market: the existence of formal and informal employment and the fact that formal sector employment may well be rationed. Using data from Yaoundé, they find that the wage elasticity of labour supply to the formal sector is 0.37, and to the informal sector is 0.49. These are remarkably close to a consensus estimate of the female labour supply elasticity in the United States of 0.4. (See Krueger and Meyer, 2002, who also note that there is a very wide range of estimates in the literature.)

Estimates of other exogenous variables' effects on labour supply are less common, especially in Africa. Given the interest in the joint determination of labour supply, fertility and investments in children, it would be particularly interesting to understand the effects of fertility policies (e.g., ensuring the availability of modern family planning) on labour supply, and also policies that facilitate investments in child quality. Clearly, in Africa, there is much room for each of the methods outlined here to improve our understanding of women's labour force participation and fertility decisions.

Determinants of fertility. The literature on the determinants of fertility is huge, with contributions from across the social sciences. We cannot pretend to survey it

here. Instead, we focus on three questions that have received the most attention from economists: the impact of women's wages on fertility; the impact of child mortality on fertility; and the impact of family planning policies. Much of this literature comes, again, from the United States, with relatively few papers to be found on Africa. The issues are considered in the following paragraphs:

- ***Wage elasticities:*** Fleisher and Rhodes (1979) provide one of the first estimates of the fertility response to women's wages, using the structural model described above. They find a rather high elasticity of child quantity to the female wage rate of -0.43, and a similarly large elasticity with respect to male wages (taken to be a pure income effect) of 0.29. Thus, the compensated elasticity for women's wages is quite negative.

As we noted above, however, the wage rate is not exogenous to fertility, because wages depend on experience, which is usually less for women who have had more children. Whether Fleisher and Rhodes successfully instrument wages is debatable. In particular, their reliance on education as an instrument for wages, a common practice, is doubtful. As we have noted, in many societies, it is socially difficult for pregnant girls to attend school. Thus, a pregnancy may terminate a girl's schooling, reversing the causation from fertility to schooling. Further, it is doubtful that education can be excluded from the fertility equation, as it may well affect fertility through attitudes and norms, not just through its effect on wages.¹³

Keeley (1980) uses experimental data on wages from several negative income tax experiments in the United States. These experiments offered a wage subsidy to a randomly selected group of families, with a control group that did not receive the subsidy. Comparing these two groups shows only small and statistically insignificant effects of wages on fertility. Although the randomisation guarantees that the wage variation is exogenous, it may not be measuring what we want. In particular, if participants understood the subsidy to be temporary (which it was), then its value over a lifetime is significantly less than a permanent wage increase, say, from improved labour market opportunities, so the impact on labour market choices would be lessened.

Schultz (2001) suggests two alternatives to identifying the effects of wages on fertility, although we are unaware of applications in Africa. The first is to use information on the local structure of wage opportunities available to all women with given sets of characteristics (experience and education). This usually requires data collection at the community level (in labour markets), but such data are increasingly common and rich in such studies as living standards measurement surveys (LSMS). A second possibility is to look at the gender gap, i.e., the difference between wages for women and those for men with similar characteristics. While each of these would be feasible in many cross-section data sets, they do present the problem that as location-specific characteristics, they may proxy other unobservable location effects

and, more importantly, they may be chosen by the women in the sample through migration.¹⁴

- ***Family planning services and fertility:*** Unlike wages or fertility shocks, family planning services are often the result of a public policy decision and, as such, are more readily addressed in the evaluation framework that is increasingly important in economics. Ravallion (1999) gives an informal introduction to the evaluation literature for development economists. This literature identifies several important statistical problems for estimating the effect of family planning services on fertility. The first and most common is the programme placement effect (Pitt *et al.*, 1995). If, for example, the government consciously places family planning services in the highest fertility areas (where, one might argue, they can do the most good), then a regression of fertility on the availability of such services will have a strong bias, and may make it appear as if family planning *increases* fertility. A standard method to deal with this bias is to use a panel that observes communities at two different points in time. This permits a fixed effects control for community characteristics, including pre-existing fertility rates. Gertler and Molyneaux (1994) use this method in Indonesia and find that family planning services have only a minor impact on fertility.

While fixed effects methods may eliminate the programme placement bias, they do not help with another source of bias, migration. For example, if people with low fertility preferences move to areas where family planning services are available, that will make it appear that the services have more of an impact on fertility than they actually do. Perhaps the only convincing way to solve this problem is to make use of a randomised experiment. Given the interest in this theme, randomised evaluations of family planning services are relatively rare. Sinha (2005) reports only one such evaluation in rural Bangladesh.¹⁵ She finds that the availability of randomly placed family planning services reduced fertility by 0.39 children per woman. Compared with an average fertility of 4.29, this is a rather small reduction, about 9 per cent. This compares to reductions of 7–8 per cent per year of schooling in the same sample. Thomas and Maluccio (1996) find similarly small effects for non-experimental data in Zimbabwe.

Why might the effect of family planning be so small? Those who believe that family planning services should have a large impact on fertility argue, implicitly or explicitly, that many births are unwanted and occur only because parents do not have access to contraception. However, evidence of two different types suggests that this is not the case. First, DHSs regularly show that women in poor countries express a preference for large families. In Africa, total desired fertility of six or more children is typical, and unwanted pregnancies are rare (Westhoff and Bankole, 2002). Given this high demand for fertility, it is not surprising that access to family planning does not have a large impact. Second, historians have long noted that fertility declined in the

developed countries long before modern family planning methods were available. (See Schultz, 2001, for a review.) They use this as evidence that the key to fertility decline is reduced demand for children, not a technological fix.

- ***Child mortality and fertility:*** The original description of the demographic transition suggested that child mortality is an important determinant of fertility. If parents have a desired number of children, high mortality probabilities will encourage them to have more than that number. This effect is likely to be especially strong if children are seen as old-age insurance. The risk of growing old without enough children to provide adequate support is catastrophic, so that risk-averse parents have a strong incentive to have more children than even the expected value of surviving children suggests are needed.

Despite this theoretical importance, relatively few papers examine child mortality as a cause of fertility in Africa. An important exception is Benefo and Schultz (1996). Using standard Hausman tests, these authors find that child mortality is exogenous in a fertility regression, despite the common notion that children of higher fertility women are at greater risk.¹⁶ Using OLS, they find strong fertility responses to child mortality. In Côte d'Ivoire, the "replacement" is complete – with each child death leading to another birth, on average – while in Ghana, it is about one half. Using two-stage least squares (2SLS), however, with community characteristics as instruments, they find no effect of mortality on fertility, an implausible result they may be due to poor instruments.¹⁷

Determinants of child quality. As with women's labour supply, there is a large literature on the determinants of children's schooling and their health status, the two measures of "child quality" that dominates the literature. Glewwe (2002) provides a review of the former, while Strauss and Thomas (1995) review the latter. Here, too, fertility considerations all too often enter the analysis as an afterthought, usually with the inclusion of household size and composition variables as regressors. But of course, if our model is correct, these should be seen as jointly determined with child quality, so their inclusion in the model leads to biased estimates.

Most of the literature on children's health and education outcomes pays little attention to the interactions among women's labour supply, fertility and child quality. Instead, the concern has been primarily to understand the effects of public policy on outcomes in education and health. As with the fertility literature, there is considerable debate about many effects, but there is a clear and consistent correlation between parents' education levels and the health and education of their children, even after controlling for income and other determinants.

There is a smaller literature that looks at how determinants of labour supply, fertility and child quality interact. Schultz (2005) uses the same "twins shock" strategy cited above to study the impact of unexpected fertility on a variety of

measures of wellbeing. Even though he finds no significant effect on household incomes, he does find that older children in a twins household have weight-for-height¹⁸ ratios that are 0.1–0.2 standard deviations below comparable siblings in single-birth households, suggesting that unexpected fertility causes lower child quality. Sinha (2005) uses experimental data on family planning in rural Bangladesh and finds that access to family planning services has no effect on the probability that boys or girls in the household will be enrolled in school. Lokshin *et al.* (2004) find that availability and cost of early childhood development centres in Kenya increases the probability that older siblings will attend school. Finally, Pitt (1997) studies the determinants of children's weight and height using DHS data from 14 African countries. While essentially estimating a reduced form, he does correct for possible selection bias in these estimates coming from birth fertility decisions and child mortality (to be in the sample, a child has to be born and has to survive to the survey date). In addition to the substantive results of the paper, which are standard, an important finding is that neither the fertility nor the mortality selection bias appears to be very important, thus opening the way for simpler OLS approaches to estimating such equations.

Panel data studies

Most of the studies cited above use simple cross-section data, perhaps merging the data from two different datasets (e.g., one on demography and health, another on public service provision). But panel data can be useful to understand some aspects of fertility and labour supply behaviour, particularly timing of births. Among other things, these models allow estimation of an n^{th} birth in a given time period conditional on the lag to the $(n-1)^{\text{th}}$ birth. In a well-known study, Heckman and Walker (1990) use a very long panel of Swedish women to find strong evidence for economic determinants of fertility, particularly women's wages and other household income. In Africa, Aassve *et al.* (2005) use a panel of Ethiopian households to study the dynamic relationship between fertility and poverty. They find that households that are poor in period t have period $t+1$ fertility that is similar to households that are not poor. That is, poverty does not appear to cause fertility, in the temporal sense. However, households that experience a birth in period t are more likely to become poor in period $t+1$ than other households, so fertility causes poverty.

Cross-Country, Cross-Regional and Time Series Studies

Early literature on labour supply and fertility often used cross-country or time series regressions. These regressions are plagued with all of the endogeneity problems discussed above, but with little hope for finding identification in experiments, natural or otherwise. As such, we discuss only a couple Africa-specific studies here. Wasao (1998) uses district level data in Kenya to find a simple negative correlation between female wage employment and fertility. In a more careful study, Feng and Bishai (2006) use 19 DHSs in Africa to generate district-level price of child

survival data in 97 subregions of those countries. This is done by observing how child survival varies with wealth. They then regress subregion level fertility rates on this (and other) variables, finding a very large elasticity of 1.71 for the response of fertility with respect to this price. They also find a rather small income elasticity of -0.19. Feng and Bishai interpret this as the cross-price effect of child quality on fertility, although it might well be considered an own-price effect since the dependent variable in the first stage is simply survival. Finally, Schultz (n.d.) uses cross-country regression to find that Africa is the only continent where urbanisation is strongly correlated with lower fertility.

The development of cointegration and error correction methods of estimation has been a major achievement in econometrics. A particularly useful feature of these estimators is that they provide strongly consistent estimates of the relationship between two or more jointly determined variables. This greatly eases the identification problems that we have noted throughout this section.

Researchers have begun to use these methods for fertility research. McNown and Rajbhandary (2003), for example, estimate an error correction model for fertility, female labour supply, female/male relative income and female wages for data from the United States. They conclude that there are two cointegrating relationships in these data, which they interpret as a labour supply equation and a fertility equation. While shocks to fertility do reduce labour supply, the opposite is not the case. They also find a very elastic response of fertility to female wages. Narayan and Smyth (2006) study the cointegration of fertility, infant mortality and female labour force participation in Australia. They find both fertility and infant mortality Granger-cause female labour force participation, but the opposite is not true. Similarly, in Africa, Ukpolo (2002) reports that population growth and growth in GDP per capita are cointegrated in Nigeria, but not Côte d'Ivoire. He also finds the population growth Granger-causes economic growth, but the reverse is not true.

While relatively novel, this literature is promising for African countries, assuming that sufficiently long time series on key variables are available.

Discussion

We have reviewed a variety of empirical studies that look at the determinants of female wage labour supply, fertility, and investments in children, either individually or jointly. While this literature is quite large, there are still relatively few papers on Africa, particularly papers that address in a statistically satisfactory way the interaction between the three endogenous variables. At the same time, there are many high quality data sets available in Africa for research using established methods. In our view, this leaves the field wide open for pursuing some of these important topics, using readily available datasets and methods. Research that looks at how policies intended to affect one of the endogenous variables (e.g., labour policies, family planning policies, education and child health policies) affect the other endogenous variables in the model is particularly promising and interesting.

Notes

1. Here, we abstract from family considerations and suppose that mothers alone bear and raise children.
2. This is not a realistic assumption, since the wages that one earns depend on education and work experience, both of which may, in turn, be affected by fertility. But for now, the assumption suits our purpose of developing a simple model to illustrate some key points.
3. Formally, a mathematical model would need to have a function for the joint production of children (N) and consumption goods (C) that is a function of time spent at the joint activities.
4. As do Becker and Lewis. Willis (1973) gives a model that considers labour supply, child quantity and child quality jointly.
5. This assumes, quite reasonably, that child quality is a normal good.
6. In addition to our three equations, Fleisher and Rhodes also estimate a wage equation, recognising that wages cannot be taken as exogenous insofar as fertility affects time spent in the labour market, which, in turn, affects wages. Other authors simply solve out wages, including them neither as a regressor nor as a dependent variable. Another option is to use not one's own wages, but the structure of wages where one lives, which might be taken as exogenous. See Schultz (2001) for a discussion.
7. Whether it is acceptable to count each of these as exogenous is debatable. For example, a woman with an unobserved preference for a small number of well-educated children may move to urban areas where access to family planning and high quality schools is easier. Discussion of education follows in the text.
8. This claim does not seem entirely consistent with the results that they present for the participation probit, which do show significant effects at roughly the same six- or ten-year levels of education where we see fertility effects.
9. A fourth possible approach uses a dramatic fertility policy change as an instrument. Li and Zhang (2006) use the one-child policy in China to identify fertility effects, but there has been no comparably dramatic (and discriminatory, since the policy applied only to Han Chinese) policy in Africa.
10. They do not use all twins because women with high fertility preferences are more likely to have twins by virtue of the fact that they have more births. They do, however, suggest that one could use the ratio of twins births to single births as an exogenous fertility measure.
11. They do study the effect on older siblings' labour supply, an issue to which we turn below.
12. See the review article by Rosenzweig and Wolpin (2000), which shows that even these instrumental variables strategies have important limitations.

13. It is, nevertheless, clear that education is highly correlated with fertility outcomes. Heckman and Walker (1990: 1411) go so far as to say "The only strong empirical relationship concerning completed fertility is a negative association between mother's education and children ever born".
14. This latter problem might be avoided by using the wage structure in the place where the woman was born.
15. This paper also includes a good literature review of the effect of family planning on fertility.
16. They do note several studies that find that child mortality does depend on fertility.
17. Again, they note several other studies that come to the opposite conclusion.
18. Weight-for-height is a measure of "wasting", a standard metric for children's health status.

References

- Aassve, A., E. Englehardt, F. Francavilla, A. Kedir, J. Kim, F. Mealli, L. Mencarini, S. Pudney and A. Prskawetz. 2005. "Poverty and fertility in less developed countries: A comparative analysis". ISER Working Paper 2005-13. Institute for Social and Economic Research, University of Essex.
- Ainsworth, Martha, Kathleen Beegle, and Andrew Nyamete. 1996. "The impact of women's schooling on fertility and contraceptive use: A study of fourteen Sub-Saharan African countries". *World Bank Economic Review*, 10 (1): 85-122.
- Angrist, Joshua and William Evans. 1998. "Children and their parents' labor supply: Evidence from exogenous variation in family size". *American Economic Review*, 88 (3): 450-77.
- Appleton, Simon. 1996. "How does female education affect fertility? A structural model for the Côte d'Ivoire". *Oxford Bulletin of Economics and Statistics*, 58 (1): 139-66.
- Becker, Gary and H. Gregg Lewis. 1973. "On the interaction between quantity and quality of children". *Journal of Political Economy*, 81: S279-88.
- Benefo, Kofi and T. Paul Schultz. 1996. "Fertility and child mortality in Côte d'Ivoire and Ghana". *World Bank Economic Review*, 10 (1): 123-58.
- Bongaarts, J. 1978. "A framework for analysing the proximate determinants of fertility". *Population and Development Review*, 4 (1): 105-32.
- Browning, Martin. 1992. "Children and household economic behavior". *Journal of Economic Literature*, 30 (3): 1434-75.
- Butz, William P. and Michael P. Ward. 1979, "The emergence of countercyclical U.S. fertility". *The American Economic Review*, 69 (3), 318-28.
- DeTray, Dennis. 1973. "Child quality and the demand for children". *Journal of Political Economy*, 81: S70-95.

- Feng, Zhao and David Bishai 2006. "A lower price of child survival lowers fertility: Testing quality quantity tradeoff in Africa". Paper presented at the American Society of Health Economists, Durham, North Carolina, June, 2008.
- Fleisher, Belton M. and George F. Rhodes. 1979. Women's wage rates and labor supply". *American Economic Review*, 69 (1): 14–24.
- Gertler, Paul and Jack Molyneaux. 1994. "How economic development and family planning programs combined to reduce Indonesian fertility". *Demography*, 31 (1): 33–63.
- Glewwe, Paul. 2002. "Schools and skills in developing countries: Education policies and socio-economic outcomes". *Journal of Economic Literature*, 40 (2): 436–82.
- Heckman, James and James Walker. 1990. "The relationship between wages and income and the timing and spacing of births: Evidence from Swedish longitudinal data". *Econometrica*, 58 (6): 1411–41.
- Keeley, Michael C. 1980. "The effects of negative income tax programs on fertility". *Journal of Human Resources*, 15: 675–94.
- Krueger, Alan B. and Bruce D. Meyer. 2002. "Labor supply and social insurance". NBER Working Paper No. 9014. National Bureau of Economic Research, Cambridge, Massachusetts.
- Lam, David and Kermyt Anderson. 2002. "Women's schooling, fertility, and investments in children in South Africa". Paper prepared for the annual meetings of the Population Association of America, Atlanta, Georgia.
- Lanot, Gauthier and Christophe Muller. 1997. "Dualistic sector choice and female labour supply: Evidence from formal and informal sectors in Cameroon". CSAE Working Paper No. 57. Centre for the Study of African Economies, University of Oxford, UK.
- Lehrer, Evelyn and Marc Nerlove. 1986. "Female labor force behavior and fertility in the United States". *American Review of Sociology*, 12: 181–204.
- Li, Hongbin and Junsen Zhang. 2006. "The effect of the one-child policy on fertility in China: Identification based on differences-in-differences". Mimeo. Department of Economics, The Chinese University of Hong Kong.
- Lokshin, Michael, Elena Glinskaya and Marito Garcia. 2004. "The effect of early childhood development programmes on women's labour force participation and older children's schooling in Kenya". *Journal of African Economies*, 13 (2): 240–76.
- McNown, Robert and Sameer Rajbhandary. 2003. "Time series analysis of fertility and female labor market behavior". *Journal of Population Economics*, 15 (3): 501–23.
- Narayan, Paresh Kumar and Russell Smyth. 2006. "Female labour force participation, fertility and infant mortality in Australia: Some empirical evidence from Granger causality tests". *Applied Economics*, 38 (5): 563–72.
- Notestein, Frank W. 1945. "Population – The long view". In Theodore W. Schultz, ed., *Food for the World*. Chicago: University of Chicago Press.
- Pitt, Mark M. 1997. "Estimating the determinants of child health when fertility and mortality are selective". *Journal of Human Resources*, 32 (1): 129–58.

- Pitt, Mark, Mark Rosenzweig and Donna Gibbons. 1995. "The determinants and consequences of the placement of government programs in Indonesia". In Dominique van de Walle and Kimberly Nead, eds., *Public Spending and the Poor*. Baltimore: Johns Hopkins University Press.
- Population Council. 2006. "Poverty and school dropout in Pakistan". [http://www.popcouncil.org/publications/popbriefs/pb12\(2\)_5.html](http://www.popcouncil.org/publications/popbriefs/pb12(2)_5.html).
- Ravallion, Martin. 1999. "The mystery of the vanishing benefits: Ms. Speedy Analyst's introduction to evaluation". Poverty Research Working Paper No. 2153. The World Bank, Washington, D.C.
- Rosenzweig, Mark R. and Kenneth I. Wolpin. 1980. "Life cycle labor supply and fertility: Causal inferences from household models". *Journal of Political Economy*, 88 (8): 328–48.
- Rosenzweig, Mark R. and Kenneth I. Wolpin. 2000. "Natural 'natural experiments' in economics". *Journal of Economic Literature*, 38 (4): 827–74.
- Schultz, T. Paul. 2001. *The Fertility Transition: Economic Explanations*. Discussion Paper No. 833. Economic Growth Center, Yale University, New Haven, Connecticut.
- Schultz, T. Paul. 1993. "Returns to women's education". In Elizabeth M. King and M. Anne Hill, eds., *Women's Education in Developing Countries: Barriers, Benefits, and Policies*. Baltimore: Johns Hopkins University Press.
- Schultz, T. Paul. 2005. *Fertility and Income*. Discussion Paper No. 925. Economic Growth Center, Yale University, New Haven, Connecticut.
- Schultz, T. Paul. n.d. *The Formation of Human Capital and the Economic Development of Africa: Returns to Health and Schooling Investments*. Economic Research Papers No. 37. African Development Bank, Tunis.
- Sinha, Nishta. 2005. "Fertility, child work, and schooling consequences of family planning programs: Evidence from an experiment in rural Bangladesh". *Economic Development and Cultural Change*, 38 (2): 231–61.
- Strauss, John and Duncan Thomas. 1998. "Health, nutrition, and economic development". *Journal of Economic Literature*, 36 (2): 766N817.
- Thomas, Duncan and John Maluccio. 1996. "Fertility, contraceptive choice, and public policy in Zimbabwe". *World Bank Economic Review*, 10 (1): 189–222.
- Thompson, Warren S. 1929, *Danger Spots in World Population*. New York: A.A. Knopf.
- Ukpolo, Victor. 2002. "Population growth and economic growth in Africa". *Journal of Developing Societies*, 18 (4): 315–29.
- Wasao, Samson. 1998. "Fertility and agricultural change in Kenya, 1979–1989". Working Paper No. 1. African Population and Health Research Center, Nairobi, Kenya.
- Westhoff, Charles and Akinrinola Bankole. 2002. *Reproductive Preferences in Developing Countries at the Turn of the Century*. Demographic and Health Surveys Comparative Reports No. 2. ORC Macro, Calverton, Maryland.
- Willis, R. 1973. "A new approach to the economic theory of fertility behavior". *Journal of Political Economy*, 81: S14–S64.

Estimating Returns to Reproductive Health Investments

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Information on returns to reproductive health can be used to allocate resources among activities within the health sector. Without such information, rational allocation of health resources is difficult, and at best imperfect. For example, it is not possible to decide the optimal amount of social expenditure that should be allocated to improve reproductive health without information on the opportunity cost of shifting resources from one health subsector to another. Also important in making allocative decisions of this kind, are the effects of interactions of various forms of health investments on the return to a particular investment.

Background

For most low-income countries, reproductive health inputs¹ include family planning services, obstetric care, prenatal and postnatal care, malaria treatments in pregnancy, post-abortion care, treatment of sexually transmitted infections, and nutrient supplements. Policy makers and households spend sizeable amounts of resources on these inputs annually. High economic rates of return on these social expenditures would provide strong justification for continuing and increasing the investments.

Reproductive health expenditures have the unique feature that they have the potential to benefit everyone at the beginning of life. For example, there is evidence that differences in health outcomes in adult life are due to differences in health care and nutrients received in utero and during childhood (Fogel, 2004). The benefits of childhood investments have been documented in many other studies. Whitehead (2007) notes that a poor start in life severely limits children's opportunities to achieve their full health potential throughout the life course, which suggests that returns to health investments in utero and during childhood are quite high.

Behrman and Rosenzweig (2004) argue that female infants born at low birth weight develop impairments in adult life that increase their probability of bearing low birth weight children. In particular, these authors indicate that a mother's birth weight is

* I thank the participants at the workshop on the AERC Collaborative Project on Reproductive Health, Economic Growth and Poverty Reduction in Africa for constructive comments. I am also grateful to Olu Ajakaiye for helpful discussions and suggestions. However, I am solely responsible for any errors or omissions.

positively correlated with her first child's birth weight. This evidence is consistent with the theory of technophysio evolution (Fogel and Costa, 1997), which predicts that nutritional and environmental disadvantages in early life are strongly manifested in adult life.

In addition to being a metric for measuring neonatal health status, birth weight is also an indicator of economic and social wellbeing (Strauss and Thomas, 1998; Almond *et al.*, 2005). Examples of returns to investments in birth weight have been emphasised by Alderman and Behrman (2006) who identify six types of economic returns to investments directed at increasing birth weight in developing countries. These benefits include reduced infant mortality, reduced cost of neonatal care and reduced cost of childhood illnesses. Other benefits are productivity gain from increased cognitive ability, reduced cost of chronic diseases in adults, and better intergenerational health – and thus higher labour market returns to the future generations of workers. Mwabu (2008) summarises evidence presented in Alderman and Behrman (2006) revealing that the investments needed to realise these benefits are relatively inexpensive. They include expenditures on antimicrobials and parasite treatments, insecticide treated bed nets, establishment of maternal records to track gestation weight, provision of iron and food supplements to pregnant mothers, and family planning campaigns. Quantitative information on returns to reproductive health can spur public interest in social expenditures directed at reducing maternal and infant mortality rates, which are alarmingly high in low income countries, particularly in Africa (World Bank, 2007).

Definitions and Theoretical Considerations

Although this chapter is about estimation of returns to reproductive health, it cannot be complete without a discussion of definitional, measurement and conceptual issues. Such issues provide the perspective on *reproductive health* that forms the foundation for the estimation. The discussion highlights the key issues that policy-makers need to be aware of to establish an effective reproductive health care system.

The chapter first clarifies the concept of reproductive health, illustrating how this vital form of human capital can be measured, and then explores its causal links with growth and poverty. A framework for estimating returns to reproductive health capital is formulated, and an example given from the literature on how it can be implemented.

General Perspectives

Until recently, measurement of economic returns to investments in human capital in Africa was limited to the computation of returns to education and general health (see Schultz, 1999). Recent classification of human capital into *education human capital* and *health human capital* (see Schultz and Strauss, 2008), has motivated the need to separate returns to education and human capital from returns to various

forms of health human capital. This distinction is important because technologies of producing the various forms of human capital and their distribution across age groups can be quite different. For example, investments in education in most countries are concentrated in the age group 6–25 years, with peaks in teenage years. In contrast, expenditures on health care and health maintenance are spread out over the life course, with peaks at older ages (see Mason, 1998). Thus, separating returns to various forms of human capital provides a guide for social expenditure on various forms of human capital at different stages of the life course. Likewise, health human capital is not a homogeneous good. The rate of return to health human capital differs according to the type of health capital under consideration. For example, the rate of return to reproductive health is not the same as the return to general health capital. The general health capital (as indicated by life expectancy, for example) is an average quantity that also includes reproductive health. In theory therefore, its rate of return may be smaller or larger than the return to reproductive health. Further, reproductive health is also not a uniform quantity; its return, too, could vary across its various forms.

Treating reproductive health as a homogeneous good implies that a uniform policy can be used to effectively increase its level in the population or to reduce its disparities, which is a strong assumption. Whitehead (2007:473) dramatises the unwarranted use of a uniform social policy to address different forms of health inequalities in society with an amusing but instructive quote from Mark Twain: “If your only tool is a hammer, all your problems will be nails”. This quote can be used to criticise the preoccupation of donors and national governments with vertical health programmes such as family planning and immunisations as tools for improving the reproductive health of the population.

To expand the menu of policies for improving the level and the distribution of reproductive health in the population, the various forms of reproductive health must be identified and their rates of return computed. But what exactly is reproductive health, and how is it measured? This question precedes the exercise of computing the rate of return to reproductive health capital because a numerical benefit cannot be attached to something that is not measurable.

Definitions

Reproductive health can better be understood in the context of provision and utilisation of reproductive health care services. Reproductive health care comprises interventions and services that ensure that health is maintained and promoted during the reproductive processes of the population. This definition covers services and interventions that reduce health risks related to all sexual activities irrespective of purpose. Reproductive health care preserves and enhances general health throughout the life course of individuals.

The definition of reproductive health must be consistent with the definition of general health. According to the World Health Organisation (WHO), general health

is not merely the absence of disease or infirmity, but a complete physical, mental, psychological and social well-being of an individual (WHO, 1948). This definition has the limitation that the concept of health is equated with the concept of welfare. Using the WHO definition, it is impossible to speak of the linkage between *health* and *welfare* because the two terms are used synonymously.

To facilitate an analysis of this linkage, the following definition of general health is proposed: Health is “a state of complete physical and mental well-being of an individual”. That is, the emphasis of the concept of health is on bodily and psychological wellbeing of individuals. Obviously, reproductive health is a subset of general health, which means that the term can be used to describe the state of health during certain stages of the life course of individuals. Accordingly, reproductive health can be visualised as the state of physical and mental well-being during several stages of the life course. These include in utero stage, at neonatal and childhood stages, pre-pregnancy stage, pregnancy and postnatal life cycles of females, and reproductive ages of men, particularly the adolescent stages. As a first approximation, reproductive health can be viewed as the physical and mental wellbeing of mothers, newborns, children, adolescents, and sexually active adults.

From the standpoint of such a definition of reproductive health, the economic welfare of an individual or society can be specified as:

$$W = W(H, G, I, S) \quad (1)$$

Where:

W = welfare function

H = health status

G = market goods

I = immaterial goods

S = spiritual goods

In Equation 1, health status, H , is one of the many determinants of the economic wellbeing of individuals and communities. Its other determinants include non-material or intangible goods, such as peace or environmental quality, and spiritual goods, such as prayer and beliefs as to rewards and punishments in later life. See Fogel (1999), for example, for an exposition of market, intangible and spiritual goods.

Although in Equation 1, H , G , I and S are treated as consumer goods, they can also appear as inputs into the production of goods and services. Further, while these variables are treated as exogenous to W (a proximate welfare indicator), this assumption can be relaxed to allow all the arguments in Equation 1 to be affected by a measure of W . In the case of health, H , the function showing the inputs that go into its production can be written as:

$$H = H(W_i, G_i, I_i, S_i) \quad (2)$$

Where W is an indicator of material prosperity such as household income, or growth in national income. The subscript i signifies that the arguments in the function are being treated as inputs. Notice that all the endogenous explanatory variables in Equation 1 can take the form of Equation 2.

Equations 1 and 2 permit an empirical analysis of the nexus among health, real income and poverty. For example, Equation 1 says that, all things equal, better health improves economic growth. Since reproductive health is a subset of general health, it follows that an improvement in reproductive health increases incomes and thus *ceteris paribus* reduces poverty. Similarly, equation (2) predicts that wealthier individuals or communities have better indicators of health status, reproductive health included. Equation 2 is known in the literature as the wealthier is healthier hypothesis (Pritchett and Summers, 1996).

Ajakaiye and Mwabu (2008) propose a joint production and demand framework for analysing the mechanisms through which reproductive health inputs are transformed into reproductive health outcomes. Interventions that reduce the costs of these inputs are efficiency enhancing. As indicated in Equation 2, the reduction in the cost of health inputs improves reproductive health and through Equation 1 increases wellbeing. Thus, cost-effective provision of reproductive health services is pro-poor in the sense that it improves the health of the poor as well as their labour productivity.

Improvement in the labour productivity in turn increases households' ability to purchase reproductive health inputs, which they use to accumulate health capital of their members, particularly mothers and children. This accumulation of health capital occurs at the household level, strengthening human capabilities and functionings of individuals (see Sen, 1985), and thus expanding their opportunities for higher incomes in the future (Fogel, 2004). In brief, it should be noted that demand and supply side interventions play complementary roles in the formation of reproductive health of individuals and households.

Measurement of Reproductive Health

In order to analyse reproductive health and link it to growth and welfare, there is need to measure its various dimensions. As is the case with reproductive health itself, reproductive health measures can be classified according to stages in the life course of an individual as described below.

Health Measures in the Early Stages of Life

Three measures are commonly used at the beginning of life to indicate the status of productive health: birth weight, APGAR score and size of the baby at birth. Other measures come into play as the child grows.

Birth weight

Birth weight indicates the health status of the newborn and hence the health of the foetus immediately before birth. Birth weight has been indicated to be strongly correlated with the survival probability of the newborn and with its schooling and economic achievement as an adult (see Almond *et al.*, 2005). Birth weight is also associated with the health status of the next generation, as low birth weight females are likely to give birth to low birth weight babies (Behrman and Rosenzweig, 2004). Babies who weigh less than 2,500 grams (<2.5Kg) at birth are normally considered underweight.

APGAR score

Like the birth weight, the *APGAR* score indicates health status of the neonate 1-5 minutes after birth. The *APGAR* score measures the wellbeing of the baby at birth, as indicated by the status of five physical attributes of the baby, namely: appearance or colour (*A*), pulse rate (*P*), grimace or response to some stimulus (*G*), activity (*A*), and respiration (*R*). The *APGAR* score is named after Dr. Virginia Apgar (1953), the American paediatrician who invented the measure. The *APGAR* score ranges from 0-10, with a maximum of two points being assigned to each of the five attributes. An *APGAR* score of 7–10 points generally indicates normal weight at birth, typically above 2.5kg. As the *APGAR* score approaches a value of 10, birth weight approaches 3kg (see Almond *et al.*, 2005), indicating that both measures provide the same information about the health of the baby at birth. However, the *APGAR* score takes into account the fact that oversize babies are likely to have poor health at birth. The *APGAR* score is not well correlated with future health or economic prospects of the newborn (Almond *et al.*, 2005).

Subjective size of the baby at birth

In Demographic and Health Surveys, mothers are asked to indicate whether their babies were born when they were very small, small, average, above average or large (see Moreno and Goldman, 1990). These subjective measures correlate strongly with birth weights and *APGAR* scores, with very small babies corresponding to low birth weights and low *APGAR* scores.

Health measures during the first 28 days of life

The measure under this category includes neonatal mortality rate (NMR; deaths/1,000 live births), number of neonatal deaths and neonatal morbidity. It is worth noting that 80 per cent of the countries with the highest NMR are in sub-Saharan Africa (see Lawn *et al.*, 2006; Jamison *et al.*, 2006).

Health measures during the first five years of life

Indicators of childhood health include mainly anthropometrics, e.g., weight, height; z-scores for weight or height normalised by age and child's body mass index

(BMI), and reported incidences of illnesses over a particular reference period, such as two weeks before a survey. Other indicators include infant mortality rate (IMR)² and child mortality rate (CMR).³

Measures of Health during Reproductive Age

The main health indicators under this category are disease-based measures such as frequency of sexually transmitted diseases, infertility, and anaemia. Nutrition-based measures include weight, height, and body mass index. Many of these measures can provide information about the pre-pregnancy health status for women.

Reproductive Health Services during the Maternal Cycle

It is important to note that the health of mothers is tied to a definite time pattern, which might be termed the maternal cycle, that is experienced by many women during the reproductive years (see Lawn *et al.*, 2006). The maternal cycle comprises the three successive stages of pre-pregnancy, pregnancy and postnatal periods. A woman is always at one of these stages before she exits the reproductive age. Health conditions and measures at these stages can provide critical information as to interventions that can be implemented to improve the health of mothers and children at periods when they are most vulnerable.

Health Measures during and after Delivery

Many of the measures related to delivery can be self-reported, and can include information as to whether delivery was normal, mother was injured, and whether the mother and/or the baby survived. Information on maternal mortality ratio can also be obtained at the community level.

The health indicators at the post delivery stage of the life cycle could include nutrition status of mothers such as weight and body mass index. Other indicators are fertility-related measures such as number of children and incidences of multiple births.

Reproductive Health Services

What interventions can be implemented to improve reproductive health? Although measurement of reproductive health can provide the motivation for improving its level and distribution in communities, the measures themselves cannot indicate the areas in which reproductive health investments should be made. This section highlights these areas and reveals that they differ by stage of the life course.

Basic Reproductive Health Services

At their most basic, reproductive health services refer to maternal and child health care, with the intention of ensuring that pregnancy results in a healthy child and a healthy mother. This is the focus of the fifth Millennium Development Goal (to

improve maternal health). Basic services will go a long way towards reducing Africa's maternal mortality ratio, which is many-fold greater than that of the rest of the world. The World Health Organisation has indicated that safe motherhood can be achieved if every birth is attended to by a trained personnel with midwifery skills, if transport is available for referral services and if quality basic emergency obstetric care is available.

The fundamental investments to improve the health of mothers, newborns and children can be categorised into expenditures on clinical, outreach, and family or community services. These services, which are closely linked to the life course and life cycles of an individual, include the following.

- ***Pre-pregnancy health care:*** The interventions here include clinical care to ensure proper treatment of illnesses, outreach services such as family planning and counselling to prevent unwanted pregnancy, and community-level health care services such as availability of nutrition and medical care to maintain general health in communities. Other priority reproductive health services at pre-pregnancy stage include interventions for delaying the age of conception until after 18 years, and for avoiding pregnancy after the age of 45 years.
- ***Pregnancy care:*** Clinical services at this stage comprise obstetric care, the care for the newborn, and emergency care, with the outreach interventions being restricted mainly to prenatal care packages. The community level services include counselling on desirable behaviours, and information about risks to newborns and breastfeeding practices.
- ***Childbirth care:*** Clinical services comprise obstetric and emergency care for the mother and the newborn. There are no outreach services at this stage, but community-level services to ensure clean delivery and effective early care for
- ***Postnatal and newborn care:*** Clinical services consist of emergency care for the newborn, treatment of illnesses, sepsis management and extra care for very low birth weight babies. The outreach services include counselling on healthy practices, and detection and referral of complicated cases. The community-level services comprise healthy home care for the newborns and breastfeeding support.
- ***Infant and child care:*** Clinical and outreach care consists of treatment of illnesses and vaccination of mothers and children. Community health care includes management of pneumonia, diarrhoea and malaria, and provision of nutrition information, particularly to mothers.

Other Priority Services

Interventions during the prenatal care stage cover two tetanus immunisations, iron and folate supplements to the mother, and screening and treatment of syphilis and HIV/AIDS, with a focus on prevention of mother-to-child transmission of diseases

or viruses, particularly HIV. During the delivery stage, the services of qualified obstetricians and midwives are essential to ensure proper monitoring of labour and the status of the foetus. The key postnatal services comprise infection control and cord care, provision of postpartum vitamin A to the mother, counselling of parents in home care of babies, intensive clinical care for preterm babies, and treatment and management of common illnesses at home and at health facilities.

Through the International Conference on Population and Development (ICPD) in 1994, however, the world's understanding of reproductive health was extended well beyond the basic concept of pregnancy, childbirth and postnatal/neonatal care. Reproductive health incorporates all aspects of sexual and reproductive health for both men and women and includes fertility issues, cancers of the reproductive tract, post-abortion care, and others. Of particular emphasis in the ICPD programme of action was reaching young people with appropriate services and information.

Provision of information about sexuality to adolescents, youth and sexually active adults is thus part of an essential reproductive health care package that should be broadly available to the relevant age groups. Institutions for dealing with issues of sexual rights (e.g., a right to exercise a minority sexual orientation) and sexual obligations (e.g., disclosure of one's HIV status to a partner) are important complements to routine reproductive health services such as family planning and screening and treatment for sexually transmitted infections.

Health Care Systems and Reproductive Health Services

Reproductive health services are provided within national health care systems. Effectiveness of these systems is key to the quality of the services. Thus, the necessary condition for sustainable reproductive health services of the forms indicated in sections 4.1 and 4.2 is the establishment of a functioning national health system. Information on existing health service delivery systems in private and public sectors is essential for establishing cost-effective provision of reproductive health services.

With declining health indicators, some countries are working not only to improve clinical and inpatient care of mothers and newborns, but are extending their efforts into the community. Kenya, for example, recognised the importance of community members involvement in their own health country in its second National Health Sector Strategic Plan and fully incorporated community health workers and community outreach into the health care system (Republic of Kenya, 2005). The community level is the foundation of Kenya's "health care pyramid", Mwabu (1989).

Synthesis and Estimation Issues

With the foregoing foundation of definitional, measurement and conceptual issues, our discussion now turns to how reproductive health can be measured. We specify its determinants and consider a methodology for estimating its returns.

The issue of estimation of returns to reproductive health can better be illuminated by rewriting Equation 1 in the form of a production function as follows:

$$Q = Q(R_H, X) \quad (3)$$

where Q is a measure of productivity or production in market or subsistence settings, e.g., a wage or an agricultural output, R_H is a measure of reproductive health, and X is a vector of exogenous controls, such as potential experience or education of the worker. Equation 3 says that reproductive health, R_H , is the cause of observed changes in Q ; that is, changes in Q can be associated with exogenous variation in R_H . However, it should be carefully noted that Equation 3 is a technological relationship, devoid of choices that economic agents make in the process of producing goods and services. Once these choices are introduced, the exogeneity assumption on R_H may not hold. Under the assumption that R_H is exogenous, ordinary least squares (OLS) can be used to estimate a specific functional form of Equation 3 and obtain the *effect* of reproductive health on wages or production, i.e., the *return* to reproductive health.

However, if cognisance is taken of the fact that R_H is produced by households who make decisions as to the optimal level of inputs required to produce this vital factor of production, the exogeneity assumption in Equation 3 ceases to hold. In that case, and in line with Equation 2 reproductive health in Equation 3 is endogenised as follows:

$$R_H = R_H(X, z) \quad (4)$$

where X is a vector of exogenous covariates and z comprises factors that affect R_H without directly influencing Q in Equation 3, i.e., z is a set of instruments for R_H . If for example, a wage function is being estimated, z might represent local reproductive health care infrastructure and food prices in local markets, all of which affect demand for reproductive health capital without directly influencing wages in local labour markets. Equation 4 can be viewed as a production function, or as a demand function for reproductive health capital (see Grossman, 1982). Equations 3 and 4 permit proper estimation of returns to reproductive health using two-stage least squares method (see Wooldridge, 2002).

A complication can arise if some of the elements in X in Equation 4 are endogenous, e.g., tetanus immunisation, medical care, or a behavioural input such as smoking (see Rosenzweig and Schultz, 1983). Letting X_1 represent the endogenous covariate in Equation 4, it can be endogenised as:

$$X_1 = X_1(X_2, z) \quad (5)$$

where X_2 is a set of exogenous covariates that belong in Equation 4 and must also enter Equation (5), with vector z being treated, again, as a set of instrumental variables, i.e., variables that affect X_1 , without directly influencing R_H . Equations 4 and 5 can be estimated using the framework of Rosenzweig and Schultz (1983), thus providing information both about the determinants of demand for reproductive

health inputs (X_1) as well as evidence on the effects of these inputs on the formation of reproductive health, R_H .

Since equations 4 and 5 have a common set of instrumental variables, equations 3–5 are a recursive system. That is, the generated dependent variables in (4) and (5) can successively be used to estimate (3), the equation of interest. However, because the variable, R_H , in Equation (3) is generated, the standard error of its coefficient (the estimated rate of return on reproductive health) would need to be adjusted (see Wooldridge, 2002). If data are not available to estimate equations (4) and (5), only (3) and (4) would need to be estimated.

It is important to note that equations (3) and (4) can be estimated using data from Demographic and Health Surveys or similar cross-sectional data typically collected by the national statistical bureaus of most countries in Africa. The key to the estimation is the availability of measures of reproductive health discussed above, as well as the availability of instruments for reproductive health. If, for example, information is available on the health status of mothers, such as the number of work days lost because of postnatal morbidity, and data are further available on instruments for health status of the mother, e.g., the local health infrastructure, equations (3) and (4) can be estimated using IV methods. In many household surveys, the information needed to estimate (3) and (4) is likely to be available.

Illustrative Example

This section presents estimation results from the literature to illustrate how returns to reproductive health can be computed using cross-sectional survey data. The estimation methodology is derived from Schultz (2003). Although the results presented are for general health of females, returns to reproductive health can be obtained using the same methodology.

Schultz (2003) used the IV technique to estimate the effect of health capital on wages in Ghana and Côte d'Ivoire. In the first-stage regression, he instrumented for all forms of human capital, not just health human capital (see Thomas and Strauss, 1997, for a similar estimation methodology). In the second-stage regression, the coefficients on endogenised *health* human capital variables were estimated controlling for other forms of human capital. That is, all forms of human capital were included in the wage function. Moreover, a generic set of instruments was used to endogenise the human capital variables in the wage function. Since this set of instruments has become standard (see Strauss, 1986), an example from Schultz (2003) is presented in Table 13.1. The table is illustrative and does not contain all the variables in the original study.

The diagnostic results that must be reported include the first stage F -statistics and incremental R -squares on exclusion restrictions. Following the first-stage regression, exogeneity and over-identification tests should also be carried out and their results reported (see Schultz, 2003:347).

Table 13.1: Instruments for endogenous health capital variables (*t*-statistics)

Selected instrumental variables	Forms of health human capital (dependent variables)	
	Body mass index	Height
Mother's years of education	-0.0528 (1.188)	0.0000 (1.13)
Father's years of education	-0.0148 (0.80)	0.0003 (0.16)
Mother employed in agriculture (=1)	-1.51 (8.80)	-0.0031 (1.16)
Rural Resident ^a (=1)	0.629 (3.08)	0.0067 (2.12)
Rainfall ^a (annual mm)	-0.0113 (0.94)	-0.0003 (1.62)
Sanitation and water problem (=1)	-.139 (0.52)	-0.0062 (1.56)
Immunisation campaign in last 5 years (=1)	-0.533 (1.60)	-.0037 (0.72)
Distance to nurse or doctor (km/miles)	0.0179 (0.79)	0.0000 (0.16)
Distance to permanent market (km/miles)	-0.0223 (1.36)	0.0002 (0.67)

Notes: (a) These variables are also in the wage function, and thus do not belong in the set of the identifying instrumental variables. (b) Other control variables include four age dummies, six ethnic groups, ten regions and ten local food prices.

Source: Constructed from Schultz (2003: Table A.2).

The first stage regression in Table 13.1 indicates that mother's employment in agriculture affected the health status of children negatively during their formative stages. The coefficient on the rural dummy shows that in this sample, rural women of reproductive age are taller and heavier than their urban counterparts. Although individual coefficients for most of the selected instrumental variables indicated in Table 13.1 are statistically insignificant, the null that all the coefficients are jointly equal to zero is easily rejected (see Schultz, 2003: Table 5).

Table 13.2 shows the effects of health capital variables on wages for female workers of reproductive age in Ghana. It should be mentioned that the full results from the study are not presented here and the reader is encouraged to consult the original study (Schultz, 2003, especially text tables 2 and 4). The OLS and IV results are presented for comparison purposes.

Table 13.2: Returns to health capital in Ghana

Health capital variables	Estimation methods N=3400 (<i>t</i> -statistics)		Sample means (std dev)
	OLS (1)	IV (2)	
BMI (body mass index (kg/m ²))	0.0420 (7.63)	0.0981 (4.11)	22.39 (4.22)
Height (meters)	1.29 (3.63)	7.48 (3.44)	1.58 (0.062)
Mean of dependent variable (standard deviation)		3.17 (1.38)	

Notes: Controls in all the regressions include region of birth, demographics, ethnicity, age group, and season of interview.

Source: Constructed from Schultz (2003: tables 2 and 4).

As can be discerned from Table 13.2, the IV estimates (column 2) are substantially larger than the OLS coefficients (column 1). Focusing on the IV estimates, it is evident that there are large returns from better health: a unit increase in mean BMI raises the log wage of Ghanaian women by 0.098, whereas an extra metre above the mean height increases the log wage by 7.48. These results imply that a unit increase in BMI in Ghana increases female wages by approximately 9.8 per cent, while a female worker who is 1 cm taller than the average worker earns about 0.25 per cent higher wage. Height can also affect labour productivity by influencing occupational choices of workers (see Fogel, 1986; Strauss and Thomas, 1995). The descriptive statistics in Table 13.2 indicate that the mean body mass for reproductive age women in Ghana in the 1980s was within the optimal range (see Fogel, 2004).

Discussion and Conclusion

Given data on wages or productivity, and data on reproductive health, consistent estimation of returns to reproductive health is straightforward. Tables 13.1 and 13.2 illustrates such estimation in line with Equation 3. The methodology for estimating equations 4 and 5, i.e., the effects of reproductive health care services on reproductive health outcomes is presented in Chapter 3 of this volume. The major challenge in the estimation of returns to reproductive health at this point lies in finding the appropriate data sets to use.

In the context of returns to reproductive health, the health capital variables in Table 13.2 can be replaced with measures of maternal morbidity, e.g., number of days ill, and whether or not a mother was injured during delivery (see Schultz and Tansel, 1997). The effect of maternal morbidity on wages can then be estimated, as in Table 13.2, controlling for other human capital variables such as the education of the mother and that of her spouse. The health capital variables in Table 13.2 can be replaced with birth weight of children or by measures of nutritional status, such as the children's BMI, i.e., weight/height (see Schultz and Mwabu, 2003). Schultz and Mwabu (2003) show that fertility reduces the body mass index of children, which, in line with the results depicted in Table 13.2, reduces labour productivity when children become adults. The results indicate the need to improve childhood health to avoid irreversible loss in productivity of adult labour. This finding is relevant for policies designed to raise labour productivity in sub-Saharan Africa. Since women are the main source of agricultural labour, the finding suggests that productivity in agriculture, even in the short run, can be increased by improving the general health of women by providing effective reproductive health services.

Table 13.2 reports economic rates of return to reproductive health. Other forms of returns, such as improvements in school enrolments or educational achievements, resulting from enhanced reproductive health, as measured by lower fertility rates, better child nutrition and reduced maternal morbidity can be computed using the IV methods. Remarkably, the instrumental variables indicated in Table 13.1 would be the relevant exclusion restrictions in this case.

In summary, this paper has clarified how reproductive health can be measured, and further demonstrated the methodology for estimating the economic returns associated with this vital form of human capital. Information on economic and social returns to reproductive health can be used to justify additional public expenditures on interventions that improve the health of vulnerable groups, particularly mothers and children in low-income areas in Africa and elsewhere.

Notes

1. Inputs into the formation of reproductive health are described in Chapter 3 of this volume, “The Demand for Reproductive Health Services: Frameworks of Analysis”.
2. The number of deaths of infants under one year of age per 1,000 live births in a given year.
3. The number of deaths of children under five years of age per 1,000 live births in a given year.

References

- Alderman, Harold and Jere R. Behrman. 2006. “Reducing the incidence of low birth weight in low income countries has substantial economic benefits”. *World Bank Research Observer*, 2 (11): 25–48.
- Almond, Douglas, Kenneth Chay and David Lee. 2005. “The costs of low birth weight”. *Quarterly Journal of Economics*, August: 1031–83.
- Apgar, Virginia. 1953. “A proposal for a new method of evaluation of newborn infant”. *Anesthesia and Analgesia*, 32 (4): 260–67.
- Behrman, Jere R. and Mark Rosenzweig. 2004. “Returns to birthweight”. *Review of Economics and Statistics*, 86 (2): 586–601.
- Fogel, Robert W. 1986. “Physical growth as a measure of the economic well-being of populations: The eighteenth and nineteenth centuries”. In Frank Falkner and J. M. Tanner, eds., *Human Growth: A Comprehensive Treatise*, Volume 3, Second Edition, pp. 263–81. New York: Plenum Press.
- Fogel, Robert W. 1999. “Catching up with the economy.” *American Economic Review*, 89 (1): 1–21.
- Fogel, Robert W. 2004. *The Escape from Hunger and Premature Death, 1700–2100: Europe, America and the Third World*. Cambridge: Cambridge University Press.
- Fogel, Robert W. and Dora L. Costa. 1997. “A theory of technophysio evolution, with some implications for forecasting population, health care costs, and pension costs”. *Demography*, 34 (1): 49–66.
- Grossman, Michael. 1982. “The demand for health after a decade”. *Journal of Health Economics*, 1 (1): 1–3.
- Jamison, Dean T., Joel G. Breman, Anthony R. Measham, George Alleyne, Mariam Claeson, David B. Evans, Prabhat Jha, Anne Mills and Philip Musgrove, eds. 2006.

- Disease Control Priorities in Developing Countries*, Second Edition. New York: Oxford University Press.
- Lawn, Joy, Jelka Zupan, Genevieve Begkoyian and Rudolf Knippenberg. 2006. "Newborn survival". In Dean T. Jamison, Joel G. Breman, Anthony R. Measham, George Alleyne, Mariam Claeson, David B. Evans, Prabhat Jha, Anne Mills and Philip Musgrove, eds., *Disease Control Priorities in Developing Countries*, Second Edition, Chapter 27, pp. 531–49. New York: Oxford University Press.
- Mason, A. 1998. "Saving, economic growth, and demographic change". *Population and Development Review*, 14 (1): 113–44.
- Moreno, Lorenzo and Noreen Goldman. 1990. "An assessment of survey data on birthweight". *Social Science and Medicine*, 31 (4): 491–500.
- Mwabu, G. 1989. "Referral Systems and Health Care Seeking Behaviour of Patients: An Economic Analysis", *World Development*, 17 (1): 85–95.
- Mwabu, G. 2008. "Health economics for low-income countries". In T. Paul Schultz and John Strauss, eds., *Handbook of Development Economics*, Volume 4. Amsterdam: North-Holland.
- MOH. 2005. *Reversing the Trends – The Second National Health Sector Strategic Plan of Kenya: NHSSP II – 2005–2010*. Ministry of Health. Nairobi, Kenya.
- Pritchett, L., and L.H. Summers 1996. "Wealthier is healthier". *Journal of Human Resources*, 31 (4): 841–68.
- Rosenzweig, Mark R. and T. Paul Schultz. 1983. "Estimating a household production function: Heterogeneity, the demand for health inputs, and their effects on birth weight". *Journal of Political Economy*, 91 (5): 723–46.
- Schultz, T. Paul. 1999. "Health and schooling in Africa". *Journal of Economic Perspectives*, 13 (3): 67–88.
- Schultz, T. Paul. 2003. "Wage rentals for reproducible human capital: Evidence from Ghana and the Ivory Coast". *Economics and Human Biology*, 1 (3): 331–66.
- Schultz, T. Paul. 2007. "Health human capital and development". Mimeo. Economic Growth Center, Yale University.
- Schultz, T. Paul and G. Mwabu. 2003. "Causes and consequences of fertility in contemporary Kenya". Mimeo. Economic Growth Center, Yale University.
- Schultz, T. Paul and John Strauss, eds. 2008. *Handbook of Development Economics*, Volume 4. Amsterdam: North-Holland.
- Schultz, T. Paul and A. Tansel. 1997. "Wage and labor supply effects of illness in Côte d'Ivoire and Ghana: Instrumental variable estimates for days disabled". *Journal of Development Economics*, 53: 251–86.
- Strauss, J. 1986. "Does better nutrition raise farm productivity". *Journal of Political Economy*, 94 (2): 297–320.

- Strauss, J. and D. Thomas. 1995. "Human resources: Empirical modeling of household and family decisions". In J. Behrman and T.N. Srinivasan, eds., *Handbook of Development Economics*, Vol. 3A, pp. 1883–2023. Amsterdam, North-Holland.
- Strauss, J. and D. Thomas. 1998. "Health, nutrition, and economic development". *Journal of Economic Literature*, 36 (2): 766–817.
- Thomas, Duncan and John Strauss. 1997. "Health and wages: Evidence on men and women in Brazil". *Journal of Econometrics*, 77 (1):159–85.
- Whitehead, Margaret. 2007. "A typology of actions to tackle social inequalities in health". *Journal of Epidemiology and Community Health*, 61: 473–78.
- Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data*. Cambridge, Massachusetts: MIT Press.
- World Bank. 2007. *African Development Indicators*. The World Bank, Washington, D.C.
- World Health Organisation. 1948. *Constitution of the World Health Organisation*. New York: United Nations.

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Reproductive Health, Economic Growth and Poverty Reduction in Africa: Frameworks of Analysis

Edited by Olu Ajakaiye and Germano Mwabu

This volume contains framework papers prepared for a collaborative research project on Reproductive Health, Economic Growth and Poverty Reduction in Africa, an initiative of the African Economic Research Consortium (AERC).

Taken together, the chapters in this book make a compelling argument that improvement in reproductive health is key to raising household incomes and to reducing poverty. The book reveals that the triple phenomena of better reproductive health, economic growth, and declining poverty, are likely to be found in an environment in which labour and product markets function. Further, a macroeconomic framework that encourages domestic and foreign investments and promotes social protection for current and future generations is essential.

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ISBN 9966 846 85 9



University of Nairobi Press



**African Economic
Research Consortium**

ISBN 978-9966-846-85-3



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